ENGINEERING EVALUATION/COST ANALYSIS

STANDARD CHLORINE CHEMICAL CO. (SCCC) SITE

KEARNY, NEW JERSEY

Prepared for:

Peninsula Restoration Group

Prepared By:

Key Environmental, Inc.
Pittsburgh, Pennsylvania

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LIST OF ABBREVIATIONS/ACRONYMS

ACO	Administrative Consent Order
AOCs	Areas of Concern
ARARs	Applicable, or Relevant and Appropriate Requirements
ATSDR	Agency for Toxic Substances and Disease Registry
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COIs	Constituents of Interest
COPR	chromite ore processing residue
Cr	Total chromium
Cr(VI)	Hexavalent chromium
DNAPL	Dense Non-Aqueous Phase Liquid
E1UBL	estuarine-subtidal-unconsolidated bottom-subtidal
E2EM5P	estuarine-subtidal-emergent-mesohaline-irregularly flooded
EE/CA	Engineering Evaluation/Cost Analysis
EP	Extraction Procedure
ER-M	Effects Range-Median
ESI	Enviro-Sciences, Inc.
GWQS	Groundwater Quality Standards
HMD	Hackensack Meadowlands District
IRA	Interim Response Action
IRAW	Interim Response Action Workplan
IRMs	Interim Remedial Measures
KEY	Key Environmental, Inc.
LIF	Laser-Induced Fluorescence
Maxus	Maxus Energy Corporation
MSL	Mean Sea Level
NJDEP	New Jersey Department of Environmental Protection
NJDHSS	New Jersey Department Health & Senior Services
NJVD	National Geodetic Vertical Datum
NRDCSCC	Non-Residential Direct Contact Soil Cleanup Criteria
NWI	National Wetlands Inventory
PAH	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PEM1E	palustrine emergent persistent seasonal saturated wetlands
PEM5R	palustrine-emergent-mesohaline-seasonal tidal
POWHx	palustrine open water intermittently flooded diked/impounded excavated
PRG	Peninsula Restoration Group
PRP	Potentially Responsible Party
PUBHx	palustrine-unconsolidated bottom-permanently flooded-excavated
RI	Remedial Investigation
SCCC	Standard Chlorine Chemical Company
SITE	Standard Chlorine Chemical Company Site
SRI	Supplemental Remedial Investigation

LIST OF ABBREVIATIONS/ACRONYMS

SVOC	Semi-Volatile organic compounds
SWQC	Surface Water Quality Criteria
TAL	Target Analyte List
TCDD	Tetrachlorodibenzo-p-dioxin
TCL	Target Compound List
Tierra	Tierra Solutions, Inc.
TOC	Total Organic Carbon
TSCA	Toxic Substances Control Act
USEPA	United States Environmental Protection Agency
USFWS	United States Fish & Wildlife Surface
VOCs	Volatile organic compounds

EXECUTIVE SUMMARY

This Engineering Evaluation/Cost Analysis (EE/CA) for the Standard Chlorine Chemical Company Site (Site) in Kearny, New Jersey has been prepared for the Peninsula Restoration Group (PRG) by Key Environmental, Inc. (KEY). The Site is currently listed on the National Priorities List and is subject to the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act. The EE/CA has been prepared in response to a request by the United States Environmental Protection Agency (USEPA). The PRG consists of the cooperating respondents interested in remediating the Site: specifically Standard Chlorine Chemical Co., Inc. (SCCC), Tierra Solutions, Inc. (Tierra) and Beazer East, Inc. (Beazer).

This EE/CA is focused in nature and addresses two potential interim response actions for the Site. One of these response actions is the response outlined in an Interim Response Action Workplan (IRAW) previously submitted to the New Jersey Department of Environmental Protection (NJDEP) as amended via an addendum. The IRAW scope of work is discussed in detail in two project planning documents (Key Environmental, Inc., October 2008 and Key Environmental, Inc., March 2009).

The second response action consists of no additional action at the Site at the current time and is referred to herein as the "no additional action" alternative. This document has been prepared based on guidance outlined in two USEPA documents regarding the completion of non-time-critical removal actions (USEPA, August 1993 and USEPA, December 1993). This executive summary consists of the following discussions:

- site conditions
- previous investigations and response actions
- potential response actions
- response action evaluation
- recommended response action

Site Conditions

The Site Location and Current Site Conditions are shown on Figures 1-1 and 1-2, respectively. The Site occupies an area of approximately 25 upland acres. The Site is bounded by the Hackensack River to the northeast, Belleville Turnpike to the southwest, the former Diamond Site to the north and northwest, and the Koppers Seaboard Site to the south and southeast. Manufacturing operations were conducted at the Site by various entities between 1916 and 1993. These operations included: the manufacturing of lead-acid storage batteries, the recovery of lead from lead oxides, the refining of naphthalene; the manufacture of products from naphthalene, naphthalene derivatives, and dichlorobenzenes; the manufacture of dye-carriers; the formulation of drain cleaning products; and, on a limited basis during the mid-1970s, the processing of trichlorobenzene.

The surface of the Site is relatively flat and ranges in elevation from approximately 3 feet to 10 feet above mean sea level (msl). Areas of greater topographic relief exist along the Hackensack River shoreline and in the vicinity of two lagoons in the eastern portion of the Site (berms). Surface drainage is primarily to the Hackensack River via a drainage ditch that exists along the southern side of the Site and storm sewer along the northern Site boundary.

The Hackensack River adjacent to the Site is classified as an SE2 water body (saline estuarine waters with designated uses as described in Section 1.1). The Site is situated at the southern end of the Hackensack Meadowlands District (HMD). The HMD is an important ecological resource and is an Atlantic flyway stopover and nesting point for migratory birds.

The Site was originally marshlands. On the Site, the marshlands were filled with between 2 to 8 feet of material to accommodate development. A generalized geologic cross-section of the Site is shown on Figure 1-3. Fill material constitutes the uppermost "soil" horizon at the Site. The original marsh surface, now located beneath the fill materials, consists of silt, humus, and peat. This layer is regionally referred to as the "meadow mat" and is typically two to four feet thick across the peninsula. A sand unit (the "deeper sand unit") is present beneath the meadow mat and is generally less than ten feet thick at the Site. This deeper sand layer is continuous across the Site. A varved clay unit is present beneath the deeper sand unit. The varved clay unit is continuous beneath the Kearny peninsula and is estimated to be approximately 40 feet thick at a minimum beneath the Site.

Two separate shallow groundwater-bearing units have been the focus of the groundwater investigation activities performed at the Site: 1) a shallow fill unit; and 2) a deeper sand unit that underlies the meadow mat and overlies the varved clay. The water table occurs in the shallow fill material overlying the meadow mat.

Groundwater flow in the shallow fill unit at the Site appears to be influenced by recharge and discharge phenomena. A potentiometric mound, resulting from recharge from precipitation, exists in the shallow fill material in the vicinity of the lagoons at the Site. Groundwater flows in a radial manner away from this potentiometric mound in the lagoon area. A potentiometric surface map for the shallow fill unit is shown on Figure 1-4.

Historically, groundwater flow in the southern portion of the adjacent Diamond Site and the northern portion of the Site was toward a 48-inch diameter storm sewer located along the boundary between the two Sites. Based on evaluation of the potentiometric data, it was possible that the storm sewer (and/or the backfill surrounding it) served as a localized discharge point for groundwater in the fill unit. As part of activities performed by Tierra Solutions, Inc., for the adjacent Diamond Site, storm sewer repairs (grouting and pipe rehabilitation) were completed in September 2008 to mitigate the potential for groundwater discharges via the storm sewer and/or surrounding backfill.

Beyond the influence of the mound in the lagoon area and the potentiometric low in the vicinity of the sewer, groundwater flow in the shallow fill material at the Site is primarily to the south-southeast toward a drainage ditch in the southern portion of the Site. Groundwater in the shallow fill unit in the eastern portion of the Site flows to the east and discharges to the Hackensack River.

Groundwater in the deeper sand unit beneath the meadow mat exists under semi-confined conditions. The underlying varved clay acts as an effective barrier to the downward migration of groundwater from this unit. Groundwater flow in the deeper sand unit is primarily to the south-southeast, sub-parallel to the direction of flow in the river.

A Public Health Assessment was completed by the Agency for Toxic Substances and Disease Registry for the Site in 2005. Fishermen at Laurel Hill Park (located approximately 0.5 miles upstream of the Site) and at the confluence of Penhorn Creek and the Hackensack River (located approximately 0.5 miles downstream of the Site) were identified by the ATSDR as potential receptors although a complete exposure pathway has not been confirmed. Exposures via the air pathway were consider indeterminate and remaining pathways such as direct contact onsite or as a result of recreational use of the river were considered incomplete or insignificant.

No federally-listed threatened or endangered species have been observed onsite to date. State-listed species such as northern harrier hawks (*Circus cyaneus* – state endangered list), black-crowned night herons (*Nycticorax nycticorax* – state threatened list), and yellow-crowned night herons (*Nyctanassa violacea* – state threatened list) roost at the Site according to the ATSDR Public Health Assessment.

Additionally, according to the United States Fish and Wildlife Service, state- and federally-listed threatened or endangered species have historically been observed in the Hackensack River watershed, and include the following: bald eagle (*Haliaeetus leucocephalus* – state endangered list); shortnose sturgeon (*Acipenser brevirostrum* – federal endangered list), dwarf wedgemussel (*Alasmidonta heterodon* – federal endangered list), bog turtle (*Clemmys muhlenbergii* – federal threatened list), and Indiana bat (*Myotis sodalist* – federal endangered list).

Previous Investigations

Previous investigations have focused on specific Areas (or media) of Concern. The following Areas (Media) of Concern have been identified for the Site and are depicted on Figure 1-7:

- Area of Concern 1 – Lagoon Solids;
- Area of Concern 2 – Western Area Soil;
- Area of Concern 3 – Eastern Area Soil;
- Area of Concern 4 – Shallow Fill Unit Groundwater;
- Area of Concern 5 – Deeper Sand Unit Groundwater;
- Area of Concern 6 – Bedrock Groundwater;
- Area of Concern 7 – Dense Non-Aqueous Phase Liquid;
- Area of Concern 8 – Drainage Ditch Surface Water;
- Area of Concern 9 – Hackensack River Near Shore Surface Water;
- Area of Concern 10 – Drainage Ditch Sediments;
- Area of Concern 11 – Hackensack River Near Shore Sediments; and,
- Area of Concern 12 – Transformer Area.

Based on review of the historical Site operations and available chemical-analytical data for the Areas of Concern (AOCs), various primary potential sources have been identified for the Site. These primary potential sources are as follows:

- Lagoon Solids (AOC 1)
- Western Area Soil (AOC 2)
- Eastern Area Soil (AOC 3)
- Dense Non-Aqueous Phase Liquid (AOC 7)
- Drainage Ditch Sediments (AOC 10)
- Transformer Area Soil (AOC 12)

Lagoon Solids - The lagoon solids consist primarily of naphthalene crystals impacted with (comparatively) low concentrations of other polynuclear aromatic hydrocarbons, chlorinated benzenes, and various dioxins and furans. The lagoon solids are relatively hard materials in most locations as evidenced by the difficulty in drilling through the materials with a vibracore sampler during the Weston investigation completed in 1987. Based on the profile of the lagoon solids developed as a result of the Weston investigation, the volume of these materials was estimated to be 7,300 cubic yards. The lagoon is surrounded by a berm which was constructed as an interim measure to prevent release via flooding and runoff. Consequently, barring flooding of the area, the water-insoluble components in the lagoon solids (e.g., most polynuclear aromatics and dioxins/furans) are unlikely to exhibit significant migration potential. By contrast, sparingly water soluble chemical constituents such as chlorinated benzenes and naphthalene are subject to leaching and advective transport in groundwater. These constituents have been detected in groundwater samples obtained in the vicinity of the lagoons.

Western Area Soil - The western area soil consists of approximately eight feet of fill material overlying the meadow mat. Much of this fill material contains chromite ore processing residue (COPR). These COPR soils consist of fine granular material to coarser nodules less that ½ inch in diameter. The area of the western portion of the Site is comprised of approximately 752,000 square feet (~17 acres). Various chlorinated benzenes and naphthalene have been detected in excess of standards in these soils.

The COPR soils are alkaline in nature and contain hexavalent chromium at concentrations ranging to 270 mg/kg. Hexavalent chromium is water soluble (relative to its trivalent form) and has been detected in groundwater samples obtained from the western portion of the Site. Hexavalent chromium is susceptible to reduction to its relatively immobile trivalent form in the environment. Based on available data, it appears that the organic content of the meadow mat is sufficient to promote reduction of the hexavalent chromium. Based on available groundwater data, it is evident that hexavalent chromium has not penetrated the meadow mat. The majority of the western area is covered by either pavement or coarse crushed stone/liners which were installed as Interim Measures. Consequently, under existing conditions, migration of constituents from this area via mechanisms such as leaching to groundwater, overland runoff, or fugitive emissions to the atmosphere are expected to be insignificant migration pathways.

Eastern Area Soil - The eastern area soil of primary interest consists of approximately eight feet of fill material overlying the meadow mat. Much of this fill material contains COPR. The entire area of the eastern portion of the Site is 315,000 square feet (i.e., 525 feet by 600 feet, approximately 7 acres). Excluding the area occupied by the lagoons (i.e., approximately 100 feet by 375 feet = 37,500 square feet) the area of the eastern area soils is 277,500 square feet. The surface materials in the northern portion of the Eastern Area soils AOC (i.e., those in the vicinity of the former process units) also exhibit the presence of chlorinated benzenes and dioxins/furans.

The COPR soils are alkaline in nature and contain hexavalent chromium at concentrations ranging to 244 mg/kg. Hexavalent chromium is water soluble (relative to its trivalent form) and has been detected in groundwater samples obtained from the eastern portion of the Site. Based on available data, it appears that the organic content of the meadow mat, as well as in the sediments in the Hackensack River is sufficient to promote reduction of the hexavalent chromium. Hexavalent chromium has not penetrated the meadow mat, has not been found at appreciable concentrations in the Hackensack River near shore sediments, and has not been detected in Hackensack River near shore surface water samples in excess of standards. Given the presence of hexavalent chromium, dioxins/furans, and other constituents in the surface soils, overland runoff of sorbed constituents as well as fugitive dust emissions are potential migration pathways.

Dense Non-Aqueous Phase Liquid - During historical investigations, samples of dense non-aqueous phase liquid (DNAPL) were collected for chemical characterization. The results of these analyses indicate the DNAPL is comprised primarily of 1,2,4-trichlorobenzene, naphthalene and the dichlorobenzene isomers. The DNAPL is a relatively non-viscous, dense organic material. DNAPL has been detected in both the shallow fill unit and directly above the varved clay in the deeper sand unit. The presence of DNAPL in the shallow fill unit above the meadow mat appears, for the most part, to be limited to the area immediately surrounding the lagoons and the area adjacent to Building 4. It does not appear that significant lateral migration of DNAPL in the shallow fill unit has occurred based on review of historical information. DNAPL is more widely distributed in the deeper sand unit than in the shallow fill unit, and is present directly on the top of the varved clay. DNAPL is present from west of the lagoon area to the vicinity of the former railroad right-of-way. Also, DNAPL is present in the deeper sand unit at the northern property boundary and in the area between the lagoons and the river. DNAPL was also inferred to be present in the area to south of the lagoons and along the southwest property boundary in the vicinity of Buildings 2 and 4. The DNAPL is expected to act as a source of dissolved phase groundwater impacts and migration of these dissolved phase constituents via groundwater advection is possible. The potential for migration of these dissolved phase constituents to the Hackensack River exists although Hackensack River near shore surface water sampling and analysis has not indicated the presence of the DNAPL-related constituents to date.

Drainage Ditch Sediments - During historical Site investigations, multiple sediment samples were obtained from the drainage ditch. The drainage ditch sediments may act as a potential source of impact to the Hackensack River given that discharge of overland runoff occurs via the drainage ditch. Chromium, lead, naphthalene, and dioxins/furans are the primary constituents of interest in the drainage ditch sediments. Constituents were detected in multiple sediment samples at concentrations in excess of screening benchmarks developed by the National Oceanic and Atmospheric Administration (i.e., the Effects Range-Median). Dioxin/furans were detected in multiple samples although it should be noted that concentrations were similar to those for the USEPA-designated background river sediment sample. Based on visual inspection, the drainage ditch sediments appear to consist of discolored (orange/yellow) fine-grained materials. Based on field inspection by a licensed geotechnical engineer, the sediments appear to be relatively cohesive and, consequently, may not be substantially subject to re-suspension and transport to the Hackensack River. The slope of the drainage ditch is relatively shallow and sustained high flow rates of water in the ditch have not been observed. The estimated volume of impacted sediment in the drainage ditch is 1,850 cubic yards.

Hackensack River Sediment - The near-shore sediments in the Hackensack River were characterized via sampling and analyses conducted by Enviro-Sciences, Inc. on behalf of SCCC in 2000 and by USEPA in 2002. Tierra obtained splits samples of all of the sediment samples collected by USEPA. Total chromium, various chlorinated aromatics, naphthalene and dioxins/furans were detected in the sediment samples. Chromium exceeded the ER-M in the sediment samples but hexavalent chromium was not detected. Dioxins/furans were detected at part per trillion levels in multiple samples but were not found to be markedly different from the levels measured in the USEPA-designated background sample. Based on review of the available analytical data, Hackensack River near shore sediments appear to be impacted and may impact the Hackensack River near shore surface water. Assuming that the sediment impacts extend 50 feet into the river to a depth of 3 feet along the entire Site frontage (600 feet), it is estimated that 3,300 cubic yards of impacted material are present in this source area.

Transformer Area - The former transformer area is located in the southwestern corner of the site and abuts the southwestern side of the largest onsite structure. As part of the RI, Weston collected a sample of "sediment" from the surface of a concrete pad in a former transformer area. This sample was analyzed for Polychlorinated Biphenyls (PCBs). A concrete chip sample of the transformer pad and samples of surrounding surface soils were collected for laboratory analysis as part of the Supplemental RI. These samples were also analyzed for PCBs. The results of the concrete chip sample indicated concentrations of PCBs greater than the NJDEP Non-Residential Direct Contact Soil Cleanup Criteria (NRDCSCC). PCBs were not detected in the surrounding surface soil samples. Atmospheric transport and/or overland runoff are the most likely migration pathways for the residual PCBs present at this location. It is estimated that less than 20 cubic yards of impacted material exist at this location.

Potential Response Actions

The "no additional action alternative" would consist only of continued maintenance of the existing interim remedies that were completed by SCCC in the early 1990s. The IRMs were completed in accordance with a NJDEP-approved Workplan and consisted of the following tasks:

- Installation of security fencing surrounding the former production area and lagoons;
- Addition of soil to the lagoon berm to increase its height and freeboard;
- Placement of geotextile and rip rap along the Hackensack River shoreline in the vicinity of the lagoon;
- Removal of the contents of five aboveground storage tanks; and,
- Repackaging of the asbestos-containing material removed from the former distillation building.

To mitigate potential risk of human exposure to hexavalent chromium at the property, IRMs were also implemented in February 1991 in the western and central sections of the Site. The IRMs implemented at the site were as follows:

- Asphalt pavement overlay on traffic areas with existing asphalt;
- Asphalt paving with geotextile fabric over existing soils, overlain by 4 inches of dense graded aggregate, overlain by 4 inches of asphalt of all remaining traffic areas;
- Construction of an interim surface cover in non-traffic areas west of the railroad right-of-way with geotextile/geomembrane liner overlain with 4 inches of dense graded aggregate; and,
- Dust fence barrier along the railroad right-of-way and north fence line to isolate the impacted surface soil in the former process area.

The "no additional action" alternative would focus on maintaining these interim responses although additional site investigation work would also likely be completed.

The planned IRAW response includes a combination of removal actions and containment options. Planned removal actions consist of the following:

- Removal of containerized materials;
- Removal of near-shore river sediments;
- Removal of south ditch sediments;
- Removal of vault contents;
- Removal of septic tanks and contents;
- Removal of transformer pads;
- Containment and removal of DNAPL; and,
- Containment and removal of groundwater (as necessary to promote DNAPL removal and maintain hydraulic control within the containment system).

Other aspects of the response action consist of the following:

- Offsite treatment/disposal of containerized materials;
- Onsite consolidation and/or offsite treatment/disposal of near-shore river sediments;
- Onsite consolidation and/or offsite treatment/disposal of south ditch sediments;

- Offsite treatment/disposal of vault contents;
- Offsite treatment/disposal of septic tank contents and tank demolition debris;
- Offsite treatment/disposal of transformer pads and associated soil;
- Offsite treatment/disposal of dense non-aqueous phase liquids; and,
- Onsite treatment of groundwater and discharge to surface water.

The potential for any future migration of constituents in environmental media will be addressed as part of the removal action via the use of containment options (i.e., capillary breaks, slurry walls, and steel sheet pile walls). Note that, in addition to the preceding, sealing of certain buildings in the lagoon area will also be completed as necessary to mitigate potential release of airborne particulates. The sealing of the buildings will be conducted as a separate activity pursuant to an EPA Order. Furthermore, all regional, State, and Federal requirements relating to wetlands, endangered species, floodplains, historic preservation, coastal zone management, transportation, disposal, and permitting will be considered during the course of the detailed design phase.

Response Action Evaluation

The "no additional action" and IRAW alternatives are evaluated in some detail in the body of this EE/CA report. In accordance with USEPA guidance, primary emphasis was placed on effectiveness, implementability, and cost.

Although the "no additional action" alternative has been effective in mitigating migration and perceived risks to a great extent, concerns still exist regarding potential releases from the Site. Consequently, the "no additional action" alternative cannot be considered effective. By contrast, all components of the IRAW alternative employ demonstrated and proven technologies and these components will be designed such that they are effective in attaining their intended objectives.

The "no additional action" alternative is readily implementable and would require only continued maintenance of existing controls. Similarly, the IRAW alternative consists of components that can be readily implemented assuming that no difficulties arise in obtaining the necessary permits for the removal action and identifying offsite treatment and/or disposal facilities. Geologic, hydrogeologic, chemical-analytical, treatability study and geotechnical data obtained to date indicate that there are no conditions which would prohibit implementation of the IRAW alternative. The individual IRAW components can be easily integrated into a final remedy.

The no additional action alternative is, by definition and comparison, inexpensive. It is estimated that approximately $20,000 per annum are expended for routine maintenance of the IRMs implemented to date at the Site. Assuming a 2-year project life and a discount factor of 5%, this equates to a present worth of $37,200 for the no additional action alternative.

The costs for implementation of the IRAW alternative are substantially greater. A detailed cost estimate displaying the projected costs for the IRAW alternative (assuming onsite consolidation of material) has been prepared. Given that the IRAW alternative is an interim remedy, a 2-year project life and a discount factor of 5% were assumed for the purposes of the present worth analysis. The projected capital, annual, and present worth costs for implementation of the IRAW alternative are as follows:

- Capital Cost - $4,652,000
- Annual Cost - $ 511,000
- Present Worth - $5,163,000

Recommended Response Action

Based on the potential for releases to the Hackensack River and to the ambient air, and as a result of discussions with the NJDEP, it is recommended that the responses outlined in the IRAW be implemented at the site. These responses, although costly, will address the major migration concerns for the Site and can readily be incorporated into a final remedy. Each of the components of the IRAW response is readily implementable and has been shown to be effective via application at other sites. It is anticipated that the data collection, design, permitting, and construction aspects of the IRAW response can be completed within approximately three years and that all interim remedies will be in place by May 2011.

1.0 SITE CHARACTERIZATION

In accordance with the guidance on non-time-critical removal actions under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), this section summarizes available data that characterizes the subject Site and surrounding areas, including current and historical information. A Site description and background discussion, a summary of previous investigation and response actions, identification of sources and the nature and extent of contamination, as well as a streamlined risk evaluation are provided. Each of these subsections is discussed in the following text.

1.1 SITE DESCRIPTION AND BACKGROUND

The location of the Site is shown on Figure 1-1 which consists of combined portions of two United States Geologic Survey 7.5 minute quadrangles (Jersey City and Weehawken, New Jersey). The general Site arrangement under current conditions is shown on Figure 1-2. The Site occupies an area of approximately 25 upland acres. The Site is bounded by the Hackensack River to the northeast, Belleville Turnpike to the southwest, the former Diamond Site to the north and northwest, and the Koppers Seaboard Site to the southeast. Railroad tracks were formerly present at the southwestern corner of the Site. A north-south trending railroad right-of-way, the site of a former rail spur which is currently owned by the Hudson County Improvement Authority traverses the Site from the northwest to southeast.

A detailed description of the Site operational history is provided in the RI Report prepared by Roy F. Weston, Inc. (Weston, May 1993) and reports titled "STANDARD CHLORINE CHEMICAL CO., INC. (SCCC) SUPERFUND SITE: Identification of Additional Potentially Responsible Party (PRP), Cooper Industries, Ltd, as successor to Thomas A. Edison, Inc." and "STANDARD CHLORINE CHEMICAL CO., INC. (SCCC) SUPERFUND SITE, Lot 50, Identification of Additional Potentially Responsible Party (PRP), Sybron Chemicals, Inc., as successor to Tanatex Chemical Corporation". In summary, manufacturing operations were conducted at the Site by various entities between 1916 and 1993. These operations included: the manufacturing of lead-acid storage batteries and the recovery of lead from lead oxides, the refining of naphthalene; the manufacture of products from naphthalene, naphthalene derivatives, and dichlorobenzenes; the manufacture of dye-carriers; the formulation of drain cleaning products; and, on a limited basis during the mid-1970s, the processing of trichlorobenzene. The naphthalene refining operations were conducted in the northeastern section of the property and the manufacture of naphthalene products in the eastern two-thirds of the Site. The manufacture of lead batteries, dichlorobenzene products, and the formulation of drain cleaning products occurred in the western one-third of the Site. Dichlorobenzene and trichlorobenzene processing was conducted in the northeastern section of the Site.

Various historical Remedial Investigation activities and Interim Remedial Measures (IRMs) have been implemented at the Site pursuant to a New Jersey Department of Environmental Protection Agency (NJDEP) Administrative Consent Order (ACO). The ACO activities conducted to date are summarized in Table 1-1. These activities have resulted in the collection of the majority of the information necessary for completion of the Site Remedial Investigation as well as this Engineering Evaluation/Cost Analysis.

In addition to the historical investigative and remedial activities listed in Table 1-1, substantial investigative activities at the Site are also planned pursuant to an Interim Response Action Work Plan (IRAW) prepared jointly for the Site and the adjacent former Diamond Site. The IRAW was submitted to the New Jersey Department of Environmental Protection (NJDEP) in October 2008 and an IRAW addendum was submitted in response to NJDEP comments in Marchr 2009 (Key Environmental, Inc., October 2008 and Key Environmental, Inc., March 2009) respectively.

The physical and environmental conditions at the Site have been characterized through the completion of a series of investigations previously identified in Table 1-1. A discussion of the historical investigations as well as prior response actions is provided in Section 1.2. The environmental conditions at the Site are summarized on an Area of Concern (or Media of Concern) basis in Section 1.3. The remainder of this section provides a description of the Site and consists of a discussion of the Site physical conditions including information regarding the following:

- Soils
- Geology
- Hydrogeology
- Topography
- Hydrology
- Ecology and wetlands
- Surrounding land use
- Potential receptor locations
- Rare, threatened, and/or endangered species

Soils

The Site was originally marshlands. On the Site, the marshlands were filled with between 2 to 8 feet of fill material to accommodate development. Fill material constitutes the uppermost "soil" horizon at the Site.

The soils at the Site are identified as NJ036 on the U.S. Department of Agriculture General Soil Map for Essex and Hudson Counties (Appendix A). The soils (NJ036) are of the Sulfaquents-Udorthents-Psamments Association and are described as follows on the General Soil Map:

> *"Nearly level, very poorly drained, very deep mineral and organic soils on tide-flooded flats, and similar areas overlain by fill materials."*

Geology

Information regarding the regional and site-specific geology has been compiled as a result of the investigations at the Site, as well as through investigation of the adjacent Diamond and Seaboard

Sites. The regional geology consists of coastal plain sediments overlying Triassic-age bedrock. Figure 1-3 is a cross-section showing the shallow subsurface geologic conditions beneath the Site.

Prior to development, the area consisted of marshlands that bordered the Hackensack River. Fill materials (the "shallow fill unit") were placed in the coastal marshlands of the region to create property for industrial/commercial development. At the Site, these fill materials generally contain COPR to depths ranging between 2 to 8 feet below the present grade.

The original marsh surface, now located beneath the fill materials, consists of silt, humus, and peat. This layer is regionally referred to as the "meadow mat" and is typically two to four feet thick across the peninsula. The upper surface of the meadow mat is undulating rather than planar. A sand unit (the "deeper sand unit") is present beneath the meadow mat and is generally less than ten feet thick at the Site. This deeper sand layer is continuous across the Site.

A varved clay unit is present beneath the deeper sand unit. The varved clay unit is continuous beneath the Kearny peninsula. The thickness of this unit beneath the Site is estimated at greater than 40 feet based on subsurface data acquired from the western section of the Seaboard Site. The vertical permeability of the varved clay unit, based on laboratory testing of Shelby tube samples collected at the adjacent Seaboard Site, averaged approximately 2.5×10^{-8} centimeters per second (cm/sec).

A glacial till unit is present beneath the varved clay. Bedrock lies directly beneath the glacial till unit at depths ranging from 70 feet in the western section of the Seaboard Site to greater than 100 feet in the eastern section of the Seaboard Site. The depth to bedrock has not been ascertained beneath the Site but is believed to be comparable to that observed in the western section of the adjacent Seaboard Site (approximately 70 feet).

Hydrogeology

Two separate shallow groundwater-bearing units have been the focus of the groundwater investigation activities performed at the Site: 1) a shallow fill unit; and 2) a deeper sand unit that underlies the meadow mat and overlies the varved clay. The water table occurs in the shallow fill material overlying the meadow mat.

The meadow mat is a reducing environment that prevents the vertical migration of hexavalent chromium (Cr[VI]) into the underlying sand (i.e., Cr[VI] is reduced to trivalent chromium - Cr[III]). Regional studies have demonstrated the existence of this reducing phenomenon (Higgins, et. al., 1998). Results for the SCCC Site are consistent with the environmental literature (i.e., hexavalent chromium has not been detected at concentrations above relevant criteria in media below the meadow mat). A Site-specific study of the reducing phenomenon was completed for the adjacent Diamond Site as is summarized in Appendix M of the Diamond Site Remedial Investigation report (Brown & Caldwell, June 2008). The meadow mat also acts as a basal semi-confining unit that limits, but does not completely eliminate, the hydraulic connection between the shallow fill materials and the underlying deeper sand unit.

Potentiometric data acquired for nested well locations during low tide indicate the existence of a downward vertical gradient between the shallow fill material and the deeper sand layer. Groundwater within the shallow fill material exists under unconfined conditions. Previous studies have indicated that the groundwater within the shallow fill material is not tidally influenced to a significant degree.

Groundwater flow in the shallow fill unit at the Site appears to be influenced by recharge and discharge phenomena. A potentiometric mound, resulting from recharge from precipitation, exists in the shallow fill material in the vicinity of the lagoons at the Site. Groundwater flows in a radial manner away from this potentiometric mound in the lagoon area.

Historically, groundwater flow in the southern portion of the adjacent Diamond Site and the northern portion of the Site was toward a 48-inch diameter storm sewer located along the boundary between the two Sites. Based on evaluation of the potentiometric data, it was possible that the storm sewer (and/or the backfill surrounding it) served as a localized discharge point for groundwater in the fill unit. As part of activities performed by Tierra Solutions, Inc., for the adjacent Diamond Site, storm sewer repairs (grouting and pipe rehabilitation) were completed in September 2008 to mitigate the potential for groundwater discharges via the storm sewer and/or surrounding backfill.

An evaluation of the storm sewer was proposed by Tierra Solutions, Inc. (Tierra) in its February 2006 response to comments on the Diamond Site RI. This evaluation was completed. Based upon this evaluation, Tierra submitted an Interim Remedial Measures (IRM) Workplan to the NJDEP in October 2006. Repairs for the storm sewer and pressure grouting of the surrounding backfill material were recommended in the October 2006 IRM Workplan. The Workplan was approved by the NJDEP and, as indicated, the work was completed and is documented in an IRM implementation report (Brown and Caldwell, September 2008).

Beyond the influence of the mound in the lagoon area and the potentiometric low in the vicinity of the sewer, groundwater flow in the shallow fill material at the Site is primarily to the south-southeast toward a drainage ditch in the southern portion of the Site. Groundwater in the shallow fill unit in the eastern portion of the Site flows to the east and discharges to the Hackensack River. The average horizontal hydraulic gradient in the shallow fill material at the Site is 0.0063 feet per foot (ft/ft). Figure 1-4 is a potentiometric surface contour map for the shallow fill unit on the Site.

Groundwater in the deeper sand unit beneath the meadow mat exists under semi-confined conditions. The underlying varved clay acts as an effective barrier to the downward migration of groundwater from this unit. Groundwater flow in the deeper sand unit is primarily to the south-southeast, sub-parallel to the direction of flow in the river.

Horizontal hydraulic gradients in the deeper sand unit are relatively flat, ranging from 0.002 to 0.008 ft/ft. Figure 1-5 is a potentiometric surface contour map for the deeper sand unit on the Site. Based on slug tests conducted during historical investigations, the average horizontal hydraulic conductivity of this unit at the Site is 5.34 feet/day ($1.9x10^{-3}$ cm/sec).
Groundwater within the deeper sand unit is tidally influenced to a limited extent. Fluctuations in potentiometric surface elevations that are correlated to tides in the Hackensack River have been observed in wells located immediately adjacent to the river. The limited tidal influence has not been observed to create significant changes in groundwater flow directions.

Topography

An aerial survey of the Site and surroundings was completed by Air Survey of Dulles, Virginia in 2004. A topographic base map was prepared as a result of the flyover and has been used for the preparation of specific Site plan view maps presented in this EE/CA. Topographic contours based on the aerial survey are depicted on one-foot contours on Figure 1-6. The horizontal reference is New Jersey State Plane Coordinates based on North American Datum (NAD 1927) and the vertical reference is National Geodetic Vertical Datum (NGVD 1929).

As shown on Figure 1-6, the surface of the Site is relatively flat and ranges in elevation from approximately 3 feet to 10 feet above mean sea level (msl). Areas of greater topographic relief exist along the Hackensack River shoreline and in the vicinity of the lagoons in the eastern portion of the Site (berms). Surface water drainage is primarily to the Hackensack River via a drainage ditch that exists along the southern side of the Site and the storm sewer located along the northern property boundary.

Hydrology

The Site is located on the Kearny Peninsula between the Passaic and Hackensack Rivers. The Passaic River is located approximately 1 mile to the west of the Site and no hydraulic connection exists between the Site and the Passaic River. By contrast, the Hackensack River is located immediately east of the Site.

The Hackensack River is approximately 45 miles long and rises in Rockland County, New York approximately 1.6 miles south of West Haverstraw. The river follows a generally meandering southerly route and is impounded at two major locations to form reservoirs (Lake Tappan and the Oradell Reservoir).

The Hackensack River, Lake Tappan, and all tributaries are classified as FW2-NT(C1) waters from the New York/New Jersey State line to the Oradell Dam (N.J.A.C. 7:9-6B). The main stem of the river and saline tributaries from the Oradell Dam to Overpeck Creek are classified as SE1. The main stem and saline tributaries from Overpeck Creek to the Route 1 and 9 crossing are classified as SE2. Finally, the main stem downstream of the Route 1 and 9 crossing is classified as SE3.

The Hackensack River adjacent to the Site is classified SE2. The Route 1 and 9 crossing is located approximately 2.5 river miles downstream of the Site. The classifications applicable to the reaches of the river adjacent to and downstream of the Site are defined as follows (N.J.A.C. 7:9-6B):

<u>SE2</u> – The SE2 classification applies to saline estuarine waters whose designated uses are:

1. Maintenance, migration and propagation of the natural and established biota;
2. Migration of diadromous fish;
3. Maintenance of wildlife;
4. Secondary contact recreation; and
5. Any other reasonable uses.

<u>SE3</u> – The SE-3 classification applies to saline estuarine waters whose designated uses are:

1. Secondary contact recreation;
2. Maintenance and migration of fish populations;
3. Migration of diadromous fish;
4. Maintenance of wildlife; and
5. Any other reasonable uses.

The flow of freshwater in the Hackensack River has been reduced by diversion for municipal water supplies. The Hackensack Water Company was created in the late 1860s to supply the cities of Hoboken, Weehawken, and Hackensack. Starting in 1901, the water company began constructing dams and reservoirs throughout the Hackensack River watershed, initially at Woodcliffe, and later at Oradell and Clarkstown. These reservoirs reduced the flow of freshwater in the Hackensack River, allowing saltwater to move upriver. In addition, dredging operations have resulted in upriver migration of salt water.

The Hackensack River is tidally influenced as far upstream as the Oradell Dam. A tidal range of approximately 5 to 6 feet occurs in the lower portion of the Hackensack River in the vicinity of the Site. Tidal information for Tidal Station 853-0696 (Hackensack River at Belleville Turnpike) located just upstream of the Site was obtained from the New Jersey Tidal Benchmark Network at http://www.njgeology.org/geodata/dgsdown/njtidalbm.pdf. Elevations relative to datum are available from http://tidesandcurrents.noaa.gov. A summary of the tidal information relative to Mean Lower Low Water (MLLW), National Geodetic Vertical Datum (NGVD) of 1929, and North American Vertical Datum (NAVD) of 1988 is as follows:

Tidal Information	Elevation (feet)(1)		
	MLLW(2)	NGVD 1929	NAVD 1988
Mean Higher High Water	5.85	8.55	7.43
Mean High Water	5.54	8.26	7.14
Mean Tide Level	2.89	5.63	4.51
Mean Low Water	0.24	2.99	1.87
Mean Lower Low Water	0.00	2.76	1.64

1. Elevation relative to indicated datum. Based on tidal epoch 1983-2001 with control at station 851-8750 (The Battery, New York). Elevations relative to NGVD and NAVD are based on averages for multiple benchmarks. As a result of this averaging, elevations computed indirectly from the tidal elevations may differ slightly from the datum-based elevations listed.
2. MLLW – Mean Lower Low Water

Surface runoff from the Site enters the Hackensack River via two primary routes: 1) a storm sewer located along the northern Site perimeter; 2) via a drainage ditch along the southern Site perimeter. The drainage ditch conveys runoff via a culvert through a berm located along the river frontage. Both the storm sewer and the drainage ditch culvert are equipped with tide gates to preclude flooding of the Site under high water conditions.

Ecology and Wetlands

The Site is located adjacent to the Hackensack River at the southern end of the Hackensack Meadowlands District (HMD). The HMD is an important ecological resource and is an Atlantic flyway stopover and nesting point for migratory birds.

Wetland maps were obtained from the National Wetlands Inventory website using the United States Fish & Wildlife Surface (USFWS) Wetlands Online Mapper which is accessible at the following URL: http://wetlandsfws.er.usgs.gov. Wetland maps for the Site and surrounding area are provided at scales of 1:40000, 1:15000, and 1:5000 in Appendix B. A table of wetlands and deepwater habitat classifications is also provided in Appendix B.

As shown on the 1:5000-scale National Wetlands Inventory (NWI) map, the wetlands in the vicinity of the Site consist primarily of subtidal or intertidal estuarine habitats. The wetland areas located closest to the Site are the Hackensack River to the east-northeast and portions of the adjacent Seaboard property to the south-southeast.

As shown on the NWI map, the Hackensack River is classified as E1UBL (estuarine-subtidal-unconsolidated bottom-subtidal). The wetlands at the northern end of the adjacent Seaboard Site are classified as PUBV (palustrine-unconsolidated bottom-permanent tidal), PEM5R (palustrine-emergent-mesohaline-seasonal tidal), and E2EM5P (estuarine-subtidal-emergent-mesohaline-irregularly flooded). The east and west lagoons on the Site are classified by the USFWS as PUBHx (palustrine-unconsolidated bottom-permanently flooded-excavated).

Princeton Hydro, LLC performed Site-specific wetland surveys for the Site in 2004 and 2008. A wetlands map based on this Site-specific survey is also provided in Appendix B. A number of freshwater emergent wetlands were identified at the Site as a result of this survey. These emergent wetlands are located in low-lying areas (specifically the southwest corner and westernmost portion of the Site), in the locations of various drainage ditches and swales (specifically in the interior of the Site and along the southern boundary), and along the Hackensack River shoreline.

The East and West Lagoons are identified as a freshwater pond on the National Wetlands Inventory map, and as a non-regulated water feature (settling basins) on the Site-specific wetlands map.

As indicated in the Site-specific wetlands delineation report, the New Jersey Freshwater Wetlands Map for the Site (Jersey City NW and Weehawken SE Quadrants) indicates palustrine emergent persistent seasonal saturated (PEM1E) wetlands in the southern section of the Site which connects to the adjacent property (the Seaboard Site), palustrine open water intermittently flooded diked/impounded excavated (POWHx) waters in the vicinity of the man-made lagoon, and Upland comprising the majority of the Site.

Surrounding Land use

Surrounding land use was reviewed with a primary emphasis on the located of sensitive environmental areas and human receptors. Land use within the 1,000-foot radius of the Site is primarily industrial in nature and no residential areas or sensitive human receptors are known to exist within this radius.

Potential Receptor Locations

The following is a list of the closest known schools, medical facilities, day care centers, and recreational areas, including the type, name, address, approximate ordinal direction relative to the Site, and approximate distance from the Site:

Type	Name	Address	Direction	Distance	
				feet	miles
School	Elementary School 23	143 Romaine Ave. Jersey City, NJ	SE	9,350	1.77
School	Dr. Charles P DeFuccio School	214 Plainfield Ave. Jersey City, NJ	SE	8,450	1.60
Recreation Area	Laurel Hill Park	New County Road Secaucus, NJ	NNE	2,750	0.52
Recreation Area	Lincoln Park	State Route 440 Jersey City, NJ	SSE	5,700	1.08
Daycare	St. Elizabeth Child Care Center	129 Garrison Ave. Jersey City, NJ	SE	9,650	1.83
Hospital	West Hudson Hospital	206 Bergen Ave. Kearny, NJ	WNW	13,350	2.53
Hospital	Jersey City Medical Center	50 Baldwin Ave. Jersey City, NJ	SW	12,720	2.41

As shown in the preceding table, no sensitive human receptors are located proximate to the Site. A Public Health Assessment was completed for the Site in 2005 (Public Health Assessment for Standard Chlorine Chemical Company, Inc., Agency for Toxic Substances and Disease Registry [ATSDR], April 5, 2005). Fishermen at Laurel Hill Park (located approximately 0.5 miles upstream of the Site) and at the confluence of Penhorn Creek and the Hackensack River (located approximately 0.5 miles downstream of the Site) were identified by the ATSDR as potential receptors although a complete exposure pathway has not been confirmed.

Rare, Threatened, and Endangered Species

No federally-listed threatened or endangered species have been observed onsite to date. According to the ATSDR Public Health Assessment, state-listed species such as northern harrier hawks (*Circus cyaneus* – state endangered list), black-crowned night herons (*Nycticorax nycticorax* – state threatened list), and yellow-crowned night herons (*Nyctanassa violacea* – state threatened list) roost at the Site.

Additionally, according to the USFWS, state- and federally-listed threatened or endangered species have historically been observed in the Hackensack River watershed, and include the following: bald eagle (*Haliaeetus leucocephalus* – state endangered list); shortnose sturgeon (*Acipenser brevirostrum* – federal endangered list), dwarf wedgemussel (*Alasmidonta heterodon* – federal endangered list), bog turtle (*Clemmys muhlenbergii* – federal threatened list), and Indiana bat (*Myotis sodalist* – federal endangered list).

1.2 PREVIOUS INVESTIGATIONS AND REMOVAL ACTIONS

Various historical remedial investigations and response actions have been implemented at the Site. This section provides a summary of the historical investigatory efforts and responses initiated to date. Investigations are discussed in subsection 1.2.1 and response actions are discussed in subsection 1.2.2.

1.2.1 Previous Investigations

Previous investigations have focused on specific Areas of Concern. The following Areas (Media) of Concern have been identified for the Site:

- Area of Concern 1 – Lagoon Solids;
- Area of Concern 2 – Western Area Soil;
- Area of Concern 3 – Eastern Area Soil;
- Area of Concern 4 – Shallow Fill Unit Groundwater;
- Area of Concern 5 – Deeper Sand Unit Groundwater;
- Area of Concern 6 – Bedrock Groundwater;
- Area of Concern 7 – Dense Non-Aqueous Phase Liquid;
- Area of Concern 8 – Drainage Ditch Surface Water;
- Area of Concern 9 – Hackensack River Near Shore Surface Water;
- Area of Concern 10 – Drainage Ditch Sediments;
- Area of Concern 11 – Hackensack River Near Shore Sediments; and,
- Area of Concern 12 – Transformer Area.

Figure 1-7 displays the locations of the various Areas of Concern. The following subsections discuss the investigations for each of the Areas of Concern. Brief discussions of the scope and the results of the historical investigations are provided.

Lagoon Solids

Residual materials, comprised of solids and oily materials, are currently present in the lagoon located in the eastern portion of the property. This subsection summarizes the investigative activities conducted to date to determine the extent and/or chemical composition of the lagoon solids.

Hydrogeologic Investigation (Weston 1984) - One sediment sample was collected from the western section and one from the eastern section of the lagoon as part of this investigation. The samples were analyzed for pH, total chromium (Cr), hexavalent chromium (Cr(VI)), and Extraction Procedure (EP) Toxicity metals.

Phase II Dioxin Investigation (NJDEP, 1985) – Two solid samples were collected for dioxin analysis. One sample was collected from the western section and one sample was collected from the eastern section of the lagoon as part of this NJDEP investigation. Based on the analytical results, which indicated the presence of dioxin in one of the samples, the NJDEP directed SCCC to conduct staged dioxin investigations.

Stage I, II, and III Dioxin Investigations (Weston, 1987 and 1988) - In February and March 1987, SCCC performed a Stage I dioxin investigation that included collection of samples from borings located in a grid fashion across the lagoon. Samples were typically collected from four separate depths at each of the 20 locations. The two deep samples from each location were archived for future analysis if the shallower samples revealed the presence of dioxin. As a result of the presence of dioxin in some of the Stage I samples, the Stage II and Stage III investigations were completed, which consisted of the analysis of these archived samples. As part of this investigation, a total of eighty (80) samples of the lagoon solids were analyzed for dioxin.

Remedial Investigation (Weston, 1993) - Two solid and two aqueous samples were collected from the lagoons and analyzed for Target Compound List (TCL) volatile organic compounds

(VOCs), semi-volatile organic compounds (SVOCs), PCBs, and Target Analyte List (TAL) metals.

As reported in the Weston RI Report, the lagoons occupy a surface area of approximately 33,000 square feet and have an average solids thickness of five to six feet. Thus, the lagoons contain approximately 7,300 cubic yards of solid material.

Attachment 1 of the IRAW includes a sample location map and Section A.1 of Attachment 1 of the IRAW includes data tables summarizing the results of the historical analyses of the lagoon solids. Testing conducted during the RI indicates that the lagoon material is comprised primarily of naphthalene, with lesser amounts of other volatile (benzene, ethylbenzene, and toluene) and semi-volatile organic compounds (polynuclear aromatic hydrocarbons and phenols). Hexavalent chromium was not detected in the lagoon solids. The results of the dioxin analyses indicate the presence of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in 46 of the 82 samples analyzed.

Western Area Soil

The investigative activities conducted to characterize the soils that are located west of the railroad right-of-way on the Site are as follows:

Hydrogeologic Investigation (Weston 1984) - Eleven soil samples were collected during monitoring well installation in the western portion of the Site. The samples were analyzed for pH, total chromium, hexavalent chromium, and EP Toxicity metals. In addition, three of the soil samples were split with the NJDEP and analyzed for VOCs.

Phase II Dioxin Investigation (NJDEP, 1985) - In May 1985, six soil samples were collected for dioxin analysis from the western portion of the Site. Areas investigated by the NJDEP included the following:

- Storage tanks in the western section of the Site near Building 2;
- Rail spur south of Building 2;
- Areas receiving drainage from southwest section of the Site (2 samples);
- Open area devoid of vegetation just west of the railroad right-of-way; and,
- Rail spur south of the warehouse.

The results of these analyses indicated that 2,3,7,8-TCDD was not present in any of the six samples.

Interim Remedial Measures Sampling (French & Parrello, 1991) - Prior to implementation of the IRMs at the Site (Section 2.5.1), additional soil sampling was performed to determine the limits of the COPR-impacted surficial fill material. Twenty-three surface soil samples were collected from the western portion of the Site and analyzed for hexavalent and total chromium.

Remedial Investigation (Weston, 1993) - Seven test pits were excavated to determine the thickness of the fill material containing COPR. One sample of the soil directly underlying the fill material was collected for analysis at each of the seven locations. These samples were analyzed for hexavalent chromium.

Three soil borings were completed to the top of the varved clay unit at locations adjacent to Building 2 where above-ground tanks were once located and chemicals for production or shipment were unloaded/loaded. Six soil samples (two from each of the borings) were analyzed for VOCs, SVOCs, pesticides/PCBs, and metals.

Focused Remedial Investigation (ERM 1997) - A total of three soil borings were advanced to the top of the varved clay unit to determine the presence/absence of Dense Non-Aqueous Phase Liquid (DNAPL), and to provide information regarding the topography of the meadow mat and varved clay. Three discrete soil samples were submitted for analysis of VOCs and "lighter weight" SVOCs.

Supplemental Remedial Investigation (Key Environmental, Inc., 1999) - Two borings were completed to the varved clay unit in the western section of the Site to investigate the possible presence of a surficial source of contamination in this area. Three soil samples from each of the borings were analyzed for SVOCs.

Attachment 1 of the IRAW includes a sample location map and Section A.2 of Attachment 1 of the IRAW includes data tables summarizing the results of the historical analyses of the Site. The results of these activities indicate the presence of chlorobenzene, 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, and naphthalene at concentrations greater than the New Jersey Non-Residential Direct Contact Soil Cleanup Criteria (NRDCSCC). In addition, surface soils in the western portion of the Site were also analyzed for hexavalent chromium during an investigation conducted by Maxus. Maxus completed Interim Remedial Measures for the Site as discussed in Section 1.2.2 (Historical Interim Remedial Measures). The results of these analyses show the presence of hexavalent chromium at concentrations ranging to 270 mg/kg.

Eastern Area Soil

The following paragraphs summarize the investigative activities conducted to characterize the soils located east of the railroad right-of-way on the Site:

Hydrogeologic Investigation (Weston 1984) - Six soil samples were collected during monitoring well installation in the eastern portion of the Site. The samples were analyzed for pH, total chromium, hexavalent chromium, and EP Toxicity metals. In addition, two of the soil samples were split with the NJDEP and analyzed for VOCs.

Phase II Dioxin Investigation (NJDEP, 1985) - In May 1985, six soil samples were collected for dioxin analysis. Areas investigated by the NJDEP included the following:

- Rail siding for naphthalene operations in the northern section of the Site, just east of the railroad right-of-way (2 samples);
- Dichlorobenzene storage tanks in the eastern section of the Site;
- Trichlorobenzene storage tanks in the eastern section of the Site;
- Area east of the lagoon; and,
- Open area devoid of vegetation in the eastern section of the Site.

The results of these analyses indicated that 2,3,7,8-TCDD was not present in five of the six samples. The only soil sample that contained a detectable concentration of 2,3,7,8-TCDD was collected in the former dichlorobenzene tank farm area.

Stage I, II, and III Dioxin Investigations (Weston, 1987 and 1988) - Surface and subsurface soil samples were collected for dioxin analyses from seven locations around the perimeter of the lagoon and from four locations along the Hackensack River bank. 2,3,7,8-TCDD was not detected in any of these samples. Additional surface soil sampling was conducted in the area between the dichlorobenzene tank farm and the distillation building, and in the area south of the lagoon. No 2,3,7,8-TCDD was detected except in one of the samples collected between the dichlorobenzene tank farm and the distillation building.

Interim Remedial Measures Sampling (French & Parrello, 1991) - Prior to implementation of the IRMs at the Site (Section 2.5.1), additional soil sampling was performed at the request of Maxus to determine the limits of the chromium impacted surface soil. Thirteen surface soil samples were collected from the eastern portion of the Site and analyzed for hexavalent chromium and total chromium.

Remedial Investigation (Weston, 1993) - Ten shallow soil samples were collected from locations around the former storage tanks adjacent to the distillation building in the eastern section of the Site. These samples were analyzed for VOCs and SVOCs. One test pit was excavated to determine the thickness of the fill material containing COPR. One sample of the soil directly underlying the fill material was collected for analysis. The sample was analyzed for hexavalent chromium.

Focused Remedial Investigation (ERM 1997) - A total of 11 soil borings were advanced to the top of the varved clay unit to determine the presence/absence of DNAPL and to provide information regarding the surfaces of the meadow mat and varved clay. Five discrete soil samples were submitted for analysis of VOCs and "lighter weight" SVOCs.

Attachment 1 of the IRAW includes a sample location map and Section A.2 of Attachment 1 of the IRAW includes data tables summarizing the results of the historical analyses of the Site soils. The results of these activities indicate the presence of chlorobenzene, 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, and naphthalene at concentrations greater than the NRDCSCC.

The investigation of surface soils in the eastern portion of the Site show the presence of hexavalent chromium at concentrations ranging to 244 mg/kg. The presence of 2,3,7,8-TCDD in soil is limited to surface soil in the vicinity of the former dichlorobenzene storage tank area.

Shallow Fill Unit Groundwater

The following summarizes the investigative activities conducted to characterize the shallow fill unit groundwater on the Site:

Hydrogeologic Investigation (Weston 1984) - Five monitoring wells were installed in the shallow fill unit (8 to 10 feet deep). Groundwater samples from each of the wells were analyzed for VOCs, base/neutral extractable organic compounds, hexavalent chromium, and total chromium.

Remedial Investigation (Weston 1993) - Five additional monitoring wells were installed in the shallow fill unit. Groundwater samples were collected from these monitoring wells and were analyzed for TCL VOCs, SVOCs, PCBs, TAL metals, and hexavalent chromium. In addition, samples from four monitoring wells adjacent to the lagoons were analyzed for dioxin.

Attachment 1 of the IRAW includes a sample location map and Section A.3 of Attachment 1 of the IRAW includes data tables summarizing the results of the historical analyses of the shallow fill unit groundwater. The results of these activities indicate that concentrations of volatile organic compounds (VOCs), chlorobenzene and dichlorobenzene isomers, and semi-volatile organic compounds (SVOCs), naphthalene and 1,2,4-trichlorobenzene, lead, and hexavalent chromium in groundwater in the shallow fill unit exceed the NJDEP Groundwater Quality Standards (GWQS) for a Class IIA aquifer. Dioxin (2,3,7,8-TCDD) was not detected in the shallow fill unit groundwater samples.

Deeper Sand Unit Groundwater

The following paragraphs summarize the investigative activities conducted to characterize the deeper sand unit groundwater on the Site:

Hydrogeologic Investigation (Weston 1984) - Five monitoring wells were installed in the deeper sand unit (18 to 20 feet deep). Groundwater samples from each of the wells were analyzed for VOCs, base/neutral extractable semi-volatile organic compounds, and hexavalent and total chromium.

Remedial Investigation (Weston 1993) - Fifteen (15) monitoring wells were installed in the deeper sand unit. Groundwater samples were collected from these monitoring wells and were analyzed for TCL VOCs, SVOCs, PCBs, TAL metals, and hexavalent chromium. In addition, samples from three monitoring wells adjacent to the lagoons were analyzed for 2,3,7,8-TCDD. A second round of sampling was conducted by Weston as part of the RI. Samples from nine wells installed within the deeper sand were analyzed for VOCs, SVOCs, chromium and lead.

Supplemental Remedial Investigation (KEY 1999) - Two additional deeper sand unit monitoring wells were installed. Groundwater samples were collected from the two new monitoring wells and were analyzed for TCL SVOCs.

Attachment 1 of the IRAW includes a sample location map and Section A.3 of Attachment 1 of the IRAW includes data tables summarizing the results of the historical analyses of the deeper sand unit groundwater. The results of these activities indicate that organic constituents of interest (COIs) in groundwater in the deeper sand unit are widely distributed across the Site.

Chlorobenzene, dichlorobenzene isomers, and naphthalene were detected in the deeper sand unit groundwater at concentrations that exceed the NJDEP GWQS for a Class IIA aquifer. Chlorinated VOCs have also been detected in the deeper sand unit along the northern property boundary. Concentrations of total chromium in the deeper sand unit groundwater also exceed the Class IIA GWQS. However, no hexavalent chromium has been detected in the deeper sand.

Bedrock Groundwater

Groundwater samples were collected for analysis in 1998 prior to sealing the former production well at the Site. The purpose of this analysis was to determine appropriate management options for groundwater displaced from the well during the abandonment procedure.

The results of the deep groundwater sample analyses are presented in Section A.4 in Attachment 1 of the IRAW. Certain high molecular weight polynuclear aromatic hydrocarbon (PAH) compounds and metals (lead and chromium) were reported at concentrations slightly greater than the NJDEP Class II-A GWQS.

Based upon the low mobility of the constituents detected in the production well samples and the absence of the more mobile and prevalent constituents present in the shallow aquifers (e.g., naphthalene and dichlorobenzenes), it is likely that the detections resulted from the introduction of surficial fill (or soil) particulates into the water column through the well bore. More than 40 feet of low permeability varved clay underlies the entire Site and separates the deeper sand unit from the upper section of the bedrock unit.

As indicated previously, the vertical permeability of this unit is on the order of 10^{-8} cm/sec. Consequently, the thickness, continuity, and low permeability of the varved clay unit preclude the advective transport of dissolved constituents through the underlying strata to the bedrock unit.

Dense Non-Aqueous Phase Liquid (DNAPL)

As part of the Focused RI, all monitoring wells were checked for the presence of DNAPL. DNAPL was detected in four monitoring wells screened in the deeper sand unit. The apparent thicknesses of the DNAPL accumulated in these wells were measured. A table summarizing these measurements is included in Section A.5 in Attachment 1 of the IRAW. Samples of the DNAPL were also collected for chemical characterization. The results of these analyses indicate the DNAPL is comprised primarily of 1,2,4-trichlorobenzene, naphthalene and the dichlorobenzene isomers. A table summarizing these results is also included in Section A.5 of Attachment 1 of the IRAW. A sample location map is provided in Attachment 1 of the IRAW.

The presence of DNAPL at the Site was further evaluated during the Supplemental RI. Delineation of the extent of DNAPL was completed using laser-induced fluorescence (LIF) technology. Thirty-one soundings were advanced to the varved clay at locations across the Site. At four locations where the LIF data were deemed inconclusive in terms of DNAPL absence/presence, confirmatory soil borings were completed.

A comprehensive evaluation of all available information regarding occurrence of DNAPL was completed as part of the SRI data evaluation process. In addition to the LIF readings, information reviewed and considered in this evaluation included boring log descriptions, DNAPL thickness measurements, soil analytical data and groundwater analytical data.

The presence of DNAPL in the shallow fill unit above the meadow mat appears, for the most part, to be limited to the area immediately surrounding the lagoons and the area adjacent to Building 4. It does not appear that significant lateral migration of DNAPL in the shallow fill unit has occurred based on review of historical information (boring logs, groundwater analytical results) and the LIF data.

The SRI results indicate that DNAPL is more widely distributed in the deeper sand unit than in the shallow fill unit, and is present directly on the top of the varved clay. This indicates that DNAPL is present from west of the lagoon area to the vicinity of the former railroad right-of-way. Also, DNAPL is present in the deeper sand unit at the northern property boundary and in the area between the lagoons and the river. DNAPL was also inferred to be present in the area south of the lagoons and along the southwest property boundary in the vicinity of Buildings 2 and 4.

Drainage Ditch Surface Water

In October 2002, the USEPA collected surface water samples for analysis from 17 locations within the Southern Drainage ditch, swales that discharge to the ditch, and a "wetland" area on the adjacent Seaboard Site that is hydraulically connected to the ditch. The samples were analyzed for TCL VOCs, TCL SVOCs, TAL metals, pesticides and PCBs. The results of these analyses are presented in the *Sampling Report for the Standard Chlorine Site.*

Attachment 1 of the IRAW includes a sample location map and Section A.6 of Attachment 1 of the IRAW includes data tables summarizing the results of the analyses of the drainage ditch surface water. The results of these analyses indicate the presence of chromium at a concentration greater than the Surface Water Quality Criteria (SWQC) in one sample (SW-12) that was collected immediately adjacent to the stone-covered area where Maxus constructed an IRM for COPR fill. Chromium concentrations in samples collected downstream of this location are less than the SWQC. The 1,2,4-trichlorobenzene concentration in the surface water sample collected furthest from the river (SW-21) also exceeded its SWQC. Concentrations of 1,2,4-trichlorobenzene in the downstream samples are less than the SWQC.

Other than the aforementioned two exceedances, concentrations of COIs in the drainage ditch surface water samples collected by USEPA are less than the respective SE2 SWQC.

Hackensack River Near-Shore Surface Water

USEPA collected four samples of water discharging to the Hackensack River during its October 2002 investigation of the Site. Three locations adjacent to the Site (designated SW-1 through SW-3) were sampled. The fourth location (SW-4) was located north of the Site and was designated by USEPA as a "background" location. Split surface water samples were collected by Tierra at these locations. The split samples were analyzed for total and hexavalent chromium.

Attachment 1 of the IRAW includes a sample location map and Section A.6 of Attachment 1 of the IRAW includes data tables summarizing the results of the analyses of the Hackensack River near shore surface water. A sample of surface water seepage along the bank of the Hackensack River collected by USEPA (SW-01) contained total chromium at a concentration of 3 mg/L, which is slightly less than the NJDEP Class SE2 SWQC of 3.23 mg/L. Total chromium was measured at concentrations of 2.09 and 0.855 mg/L, respectively, in the primary and duplicate Tierra split samples collected from this location. Hexavalent chromium was not detected in the Tierra split samples collected from this location at a detection limit of 0.010 mg/L. Hexavalent chromium analysis was not completed for the USEPA samples.

Chlorinated aromatic hydrocarbons were also detected in these samples. However, concentrations of these constituents are much less than their respective SE2 SWQC. Naphthalene concentrations in the surface water samples collected along the bank of the river ranged from less than the method detection limit (SW-01) to 0.045 mg/L (SW-02). There is no SWQC for naphthalene specified in N.J.A.C 7:9B.

Drainage Ditch Sediment

The USEPA collected sediment samples at the same 17 locations where surface water samples were collected within the drainage ditch network and the hydraulically connected wetland on the Seaboard Site. For discussion purposes only, comparison of the sediment concentration is made to the NJDEP Marine/Estuarine Screening Guidelines, Effects Range-Median (ER-M) criterion, as these criteria are used for screening purposes, are not enforceable environmental standards, and should not be construed as remediation standards that are applicable to these Sites.

Attachment 1 of the IRAW includes a sample location map and Section A.6 of Attachment 1 of the IRAW includes data tables summarizing the results of the analyses of the drainage ditch sediment samples. Chromium concentrations exceed the ER-M in all 17 samples. Naphthalene concentrations greater than the ER-M were reported in nine (9) of the 17 samples. Dioxin concentrations in the sediment samples collected on the Site were in many instances (eight of the seventeen samples collected within the ditch system), less than the background dioxin concentration measured at the USEPA-designated background location (S-04) within the river (0.000008 mg/kg). Of the nine samples where dioxin concentrations exceeded the background concentration, only four samples contained dioxin concentrations greater than 0.000080 mg/kg. Three of these samples were taken in the open water "wetland" which is hydraulically connected to the ditch and located on the adjacent Seaboard Site. Dioxin concentrations in the remaining five samples were only slightly greater than the background concentration and ranged from 0.000009 to 0.000050 mg/kg.

The dioxin investigation completed by the NJDEP identified only two areas on the Site where dioxin was present (lagoon solids and the former distillation building area). Migration of dioxin-impacted media from these areas to drainage ditches is unlikely.

Dioxin was not detected in any of the samples that were collected from monitoring wells installed around the perimeter of the lagoon. The results of groundwater analyses conducted by Weston during the RI are indicative of the immobility of dioxin in groundwater. The lagoons were constructed below the surrounding ground elevation. Hence, it is unlikely that dioxin from the lagoon solids would have been transported to the sediments via storm water runoff. The solubility of dioxin in water is extremely low and it is immobile in groundwater due to its affinity for adsorption to organic carbon in the aquifer matrix. As a result, transport of dioxin to sediments by a groundwater migration pathway is not viable.

The topography surrounding the distillation building is relatively flat, and is therefore not conducive to transport of impacted soil via overland flow. The distance from the distillation building to the branch of the southern ditch is approximately 500 feet and as a result of the relatively flat topography, it is unlikely that dioxin from this area has been transported to the sediments via overland flow.

In addition, because of the low solubility and low mobility of dioxin in groundwater, it is unlikely that the dioxin was transported to the sediments via groundwater migration and discharge. The absence of dioxin in surface soil samples collected between drainage ditches and the potential source areas where dioxin was previously detected (i.e., the lagoon and the distillation building area) suggest that migration of dioxin from these areas has not occurred.

Hackensack River Sediment

The near-shore sediments in the Hackensack River were characterized via sampling and analyses conducted by Enviro-Sciences, Inc. (ESI)[1] in 2000 and by USEPA in 2002.

ESI collected surficial sediment samples from nine locations in the Hackensack River adjacent to the Site. These samples were analyzed for VOCs, base/neutral extractable organic compounds (including a scan for dioxin), priority pollutant metals, hexavalent chromium, total organic carbon (TOC), and particle size distribution. The analytical data were provided to the NJDEP in a submittal dated October 23, 2000.

1 Enviro-Sciences, Inc., November 2000, Remedial Action Workplan.

The USEPA collected sediment samples at three locations adjacent to the Site (designated S-1 through S-3). A fourth location (S-4) was located north of the Site and was designated by USEPA as a "background" location. Sediment samples collected by USEPA were analyzed for TCL VOCs, TCL SVOCs, TAL metals, pesticides and PCBs, dioxins and furans, and TOC. Tierra collected split sediment samples at all of the locations sampled by USEPA.

Attachment 1 of the IRAW includes a sample location map and Section A.6 of Attachment 1 of the IRAW includes data tables summarizing the results of the analyses of the Hackensack River sediment. The results of the sampling and analyses completed by ESI and USEPA indicate that chromium concentrations in the near-shore Hackensack River surficial sediments exceed the ER-M criterion at eight of nine locations sampled by ESI and in each of the three (3) samples collected by USEPA. Hexavalent chromium was not detected in any of the samples collected by ESI nor in any of the split samples analyzed by Tierra. USEPA samples were not analyzed for hexavalent chromium. Naphthalene concentrations exceed the ER-M criterion in eight (8) of these twelve (12) samples. Dioxin was detected in the three surficial sediment samples collected by USEPA at concentrations ranging from 0.000040 mg/kg to 0.000096 mg/kg.

Transformer Area

As part of the RI, Weston collected a sample of "sediment" from the surface of a concrete pad in a former transformer area. This sample was analyzed for PCBs. A concrete chip sample of the transformer pad and samples of surrounding surface soils were collected for laboratory analysis as part of the Supplemental RI. These samples were also analyzed for PCBs.

Attachment 1 of the IRAW includes a sample location map and Section A.7 of Attachment 1 of the IRAW includes data tables summarizing the results of the analyses of these transformer pad area samples. The results of the concrete chip sample indicated concentrations of PCBs greater than the NRDCSCC of 2 mg/Kg. PCBs were not detected in the surrounding surface soil samples at concentrations above the NRDCSCC.

1.2.2 Historical Interim Remedial Measures

As indicated, a series of IRMs were completed by SCCC in the early 1990s. The IRMs were completed in accordance with an NJDEP-approved work plan and consisted of the following tasks:

- Installation of security fencing surrounding the former production area and lagoons to prevent unauthorized access;
- Addition of soil to the lagoon berm to increase its height and the available freeboard to prevent potential overflows;
- Placement of geotextile and rip rap along the Hackensack River shoreline in the vicinity of the lagoon;
- Removal, packaging, and secure placement of the contents of five aboveground storage tanks; and,
- Packaging and secure placement of asbestos-containing materials associated with the IRMs.

To mitigate potential risk of human exposure to hexavalent chromium at the property, IRMs were implemented by Maxus Energy Corporation (Maxus) on behalf of Occidental Chemical Corporation in February 1991 in the western and central sections of the Site[2]. The chromium IRMs implemented at the Site were as follows:

- Installation of an asphalt pavement overlay (new wearing course) on exiting asphalt-paved traffic areas;
- Asphalt paving with geotextile fabric over existing soils, overlain by 4 inches of dense graded aggregate, overlain by 4 inches of asphalt of all remaining traffic areas;
- Construction of an interim surface cover in non-traffic areas west of the railroad right-of-way with geotextile/geomembrane liner overlain with 4 inches of dense graded aggregate; and,

[2] Some of the work at the Site has been conducted under an Administrative Consent Order dated April 17, 1990 entered by NJDEP with Occidental Chemical Corporation (OCC) and Chemical Land Holdings, (CLH) Inc. (now Tierra) relating to COPR (the "Diamond ACO"). Maxus historically had responsibility for overseeing work under the Diamond ACO for OCC, as successor to Diamond Shamrock Chemicals Company.

- Installation of a dust fence barrier along the railroad right-of-way and north fence line to isolate the impacted surface soil in the former process area.

1.3 POTENTIAL SOURCES AND NATURE AND EXTENT OF IMPACT

As discussed in the preceding section, various investigations have been performed at the Site. Figure 1-8 displays sampling locations for the historical investigations. Analytical data acquired during these investigations as well as a Site map displaying the locations were previously provided as an attachment to the IRAW. Based on review of the historical Site operations and available chemical-analytical data for the Areas of Concern (AOCs), various primary potential sources have been identified for the Site. These primary potential sources are as follows:

- Lagoon Solids (AOC 1)
- Western Area Soil (AOC 2)
- Eastern Area Soil (AOC 3)
- Dense Non-Aqueous Phase Liquid (AOC 7)
- Drainage Ditch Sediments (AOC 10)
- Hackensack River Near Shore Sediments (AOC 11)
- Transformer Area Soil (AOC 12)

Each of these potential sources is discussed in the remainder of this section. The location, estimated volume, and the physical and chemical characteristics of the materials present are discussed on an AOC-specific basis.

Lagoon Solids

The lagoon solids consist primarily of naphthalene crystals impacted with (comparatively) low concentrations of other polynuclear aromatic hydrocarbons, chlorinated benzenes, and various dioxins and furans. The lagoon solids are relatively hard materials in most locations as evidenced by the difficulty in drilling through the materials with a vibracore sampler during the Weston investigation completed in 1987. Based on the profile of the lagoon solids developed as a result of the Weston investigation, the volume of these materials was estimated to be 7,300 cubic yards.

The lagoon is surrounded by a berm. Consequently, barring flooding of the area, the water-insoluble components in the lagoon solids (e.g., most polynuclear aromatics and dioxins/furans) are unlikely to exhibit significant migration potential. By contrast, sparingly water soluble chemical constituents such as chlorinated benzenes and naphthalene are subject to leaching and advective transport in groundwater. These constituents have been observed in the subsurface as a result of groundwater sampling and analysis in the vicinity of the lagoons. It is also considered likely that DNAPL observed in the monitoring wells located in the vicinity of the lagoon also originated from the lagoons.

Western Area Soil

The western area soil of consists of approximately eight feet of fill material overlying the meadow mat. Much of this fill material contains COPR. These COPR soils consist of fine granular material to coarser nodules less that ½ inch in diameter. The area of the western portion of the Site is comprised of approximately 752,000 square feet (~17 acres). Various chlorinated benzenes and naphthalene have been detected in excess of standards in these soils.

The COPR soils are alkaline in nature and contain hexavalent chromium at concentrations ranging to 270 mg/kg. Hexavalent chromium is water soluble (relative to its trivalent form) and has been detected in groundwater samples obtained from the western portion of the Site. Hexavalent chromium is susceptible to reduction to its relatively immobile trivalent form in the environment. Based on available data, it appears that the organic content of the meadow mat is sufficient to promote reduction of the hexavalent chromium. Based on available groundwater data, it is evident that hexavalent chromium has not penetrated the meadow mat.

The majority of the western area is covered by either pavement or coarse crushed stone/liners which were installed as IRMs. Consequently, under existing conditions, migration of constituents from this area via mechanisms such as leaching to groundwater, overland runoff, or fugitive emissions to the atmosphere are expected to be insignificant migration pathways.

Eastern Area Soil

The eastern area soil of primary interest consists of approximately eight feet of fill material overlying the meadow mat. Much of the fill material contains COPR. The entire area of the eastern portion of the Site is 315,000 square feet (i.e., 525 feet by 600 feet). Excluding the area occupied by the lagoons (i.e., approximately 100 feet by 375 feet = 37,500 square feet) the area of the eastern area soils is 277,500 square feet. The surface materials in the northern portion of the eastern area soils AOC (i.e., those in the vicinity of the former process units) also exhibit the presence of chlorinated benzenes and dioxins/furans.

The COPR soils contain hexavalent chromium at concentrations ranging to 244 mg/kg. Hexavalent chromium has been detected in groundwater samples obtained from the eastern portion of the Site. Based on available data, it appears that the organic content of the meadow mat, as well as in the sediments in the Hackensack River is sufficient to promote reduction of the hexavalent chromium.

Hexavalent chromium has not penetrated the meadow mat, has not been found at appreciable concentrations in the Hackensack River near shore sediments, and has not been detected in Hackensack River near shore surface water samples in excess of standards. Given the presence of hexavalent chromium, dioxins/furans, and other constituents in the surface soils, overland runoff of sorbed constituents as well as fugitive dust emissions are potential migration pathways.

Dense Non-Aqueous Phase Liquid

During historical investigations, samples of the DNAPL were collected for chemical characterization. The results of these analyses indicate the DNAPL is comprised primarily of 1,2,4-trichlorobenzene, naphthalene and the dichlorobenzene isomers. The DNAPL is a relatively non-viscous, dense organic material. DNAPL has been detected in both the shallow fill unit and directly above the varved clay in the deeper sand unit.

The presence of DNAPL in the shallow fill unit above the meadow mat appears, for the most part, to be limited to the area immediately surrounding the lagoons and the area adjacent to Building 4. It does not appear that significant lateral migration of DNAPL in the shallow fill unit has occurred based on review of historical information.

DNAPL is more widely distributed in the deeper sand unit than in the shallow fill unit, and is present directly on the top of the varved clay. DNAPL is present from west of the lagoon area to the vicinity of the former railroad right-of-way. Also, DNAPL is present in the deeper sand unit at the northern property boundary and in the area between the lagoons and the river. DNAPL was also inferred to be present in the area to south of the lagoons and along the southwest property boundary in the vicinity of Buildings 2 and 4.

The DNAPL is expected to act as a source of dissolved phase groundwater impacts and migration of these dissolved phase constituents via groundwater advection is possible. The potential for migration of these dissolved phase constituents to the Hackensack River exists although Hackensack River near shore surface water sampling and analysis has not indicated the presence of the DNAPL-related constituents to date.

Drainage Ditch Sediments

During historical Site investigations, multiple sediment samples were obtained from the drainage ditch. The drainage ditch sediments may act as a potential source of impact to the Hackensack River given that discharge of overland runoff occurs via the drainage ditch. Chromium, lead, naphthalene, and dioxins/furans are the primary constituents of interest in the drainage ditch sediments. Constituents were detected in multiple sediment samples at concentrations in excess of a conservative screening benchmark (i.e., the Effects Range-Medium). Dioxin/furans were detected in multiple samples although it should be noted that concentrations were similar to those for a background sample obtained by the USEPA.

Based on visual inspection, the drainage ditch sediments appear to consist of discolored (orange/yellow) fine-grained materials. The sediments appear to be relatively cohesive and may not be substantially subject to re-suspension and transport to the Hackensack River. The slope of the drainage ditch is relatively shallow and sustained high flow rates of water in the ditch have not been observed. The estimated volume of impacted sediment in the drainage ditch is 1,850 cubic yards.

Hackensack River Near-Shore Sediment

The near-shore sediments in the Hackensack River were characterized via sampling and analyses conducted by Enviro-Sciences, Inc. (ESI)[3] in 2000 and by USEPA in 2002. Tierra obtained splits samples of the sediment samples obtained by USEPA. Total chromium, various chlorinated aromatics, naphthalene and dioxins/furans were detected in the sediment samples.

Chromium exceeded the ER-M in the sediment samples but hexavalent chromium was not detected. Dioxins/furans were detected at part per trillion levels in multiple samples but were not found to be markedly different from the levels measured in the USEPA-designated background sample. Based on review of the available analytical data, Hackensack River near-shore sediments appear to be impacted and may act as a source of impacts to the Hackensack River near shore surface water. Assuming that the near shore sediment impacts extend 50 feet into the river to a depth of 3 feet along the entire Site frontage (600 feet), it is estimated that 3,300 cubic yards of impacted material are present in this source area.

Transformer Area

As part of the RI, Weston collected a sample of "sediment" from the surface of a concrete pad in a former transformer area. This sample was analyzed for PCBs. A concrete chip sample of the

[3] Enviro-Sciences, Inc., November 2000, Remedial Action Workplan.

transformer pad and samples of surrounding surface soils were collected for laboratory analysis as part of the Supplemental RI. These samples were also analyzed for PCBs. The results of the concrete chip sample indicated concentrations of PCBs greater than the NRDCSCC (2 mg/Kg). PCBs were not detected in the surrounding surface soil samples. Atmospheric transport and/or overland runoff are the most likely migration pathways for the residual PCBs present at this location. It is estimated that less than 20 cubic yards of impacted material exist at this location.

1.4 ANALYTICAL DATA

As discussed in the preceding section, available historical analytical data have been compiled and have been provided as attachments to preceding deliverables. A comprehensive summary of available analytical data was provided as Attachment 1 of the IRAW and this analytical summary is incorporated by reference. Discussions of the more significant implications of the available analytical results were provided in the preceding section.

1.5 STREAMLINED RISK EVALUATION

Under existing land and water use conditions, minimal risks are expected to be associated with potential onsite exposures. Contact with impacted materials by Site workers is infrequent given activity patterns and the majority of the impacted areas are either fenced or under engineered surface covers. Similarly, groundwater is not used as a drinking water source at the Site, and risks associated with exposure via use of groundwater do not exist as this is an incomplete exposure pathway.

Offsite exposures are also expected to be limited given the absence of evidence to suggest that significant offsite migration of constituents has occurred. However, as discussed in the Public Health Assessment completed by the Agency for Toxic Substances and Disease Registry (ATSDR), potential exposures via atmospheric emissions and overland runoff/groundwater discharge to the Hackensack River are essentially indeterminate. The ATSDR concluded that risks associated with recreational use of the river are likely to be insignificant with the exception of potential risks associated with fish and shellfish consumption.

According to ATSDR, existing data are currently inadequate to determine the contribution of the Site to fish tissue burdens. Note that multiple sources of impact to the Hackensack River exist, and consequently establishing a cause and effect relationship between the Site and impacts on biota or human health as a result of fish/shellfish consumption would be difficult at best. Several classes of primary constituents of interest for the Site (dioxin congeners, hexavalent chromium, and polynuclear aromatic hydrocarbons) are prevalent at multiple other Sites in the Hackensack/Passaic/Newark Bay area. The following conclusions and recommendations were been taken verbatim from the ATSDR Public Health Assessment and has formed, in part, the basis for the alternative evaluations in this EE/CA:

CONCLUSIONS

The Public Health Hazard Category recommended for the Standard Chlorine site is ***"Indeterminate Public Health Hazard"*** *for the biota and ambient air pathways. Data associated with the biota pathway is not currently available and this pathway is the most significant pathway of exposure associated with the site, partly due to the possibility of repeated exposures. There are two popular fishing locations on the banks of the river both 0.5 miles up and downstream from Standard Chlorine and hook and line fishing from boats takes place on the Hackensack River off the Standard Chlorine property. Despite the recommendations of the Fish Consumption Advisory, fishing and crabbing for consumption continues to occur. Two studies were initiated in 2004 that will characterize the bioaccumulation of dioxins, PCBs, PAHs (including naphthalene), selected pesticides, furans and chlorinated benzene compounds in fish and crab in the Newark Bay complex, including the Hackensack River. The results of these studies may enable the New Jersey Department Health & Senior Services (NJDHSS), in cooperation with the ATSDR, to evaluate the contribution of site-related contamination to the biota pathway. There is currently no community receptor population within one-mile of the Standard Chlorine site although there are residential communities beyond the one-mile radius. Additionally, future redevelopment of the site for non-industrial purposes may significantly modify population demographics. Due to lack of air monitoring data for the*

COC, it is difficult to determine the potential health impact of airborne contaminants to on- and off-site worker populations, residential communities living beyond the one-mile radius of the site, site visitors and trespassers.

The Hackensack River is utilized by families for seasonal recreational activities such as kayaking, canoeing and the use of personal water crafts (i.e., jet skiing). The recreational uses of the Hackensack River are intermittent and therefore frequent significant exposures via ingestion of sediment/surface water are unlikely. The site is potentially accessible to trespassers from the shore-bound side. As stated in the pathway analysis section, the potential for exposure to these individuals on a routine basis is unlikely. Overall, the likelihood of frequent, significant exposures to the contaminants of concern via the trespassers and recreational uses of the river pathways is unlikely. Therefore, the Public Health Hazard Category recommended for these pathways is ***"No Apparent Public Health Hazard"****.*

The Standard Chlorine site has complex environmental contamination such as dioxin-contaminated asbestos consolidated into sea boxes, dioxin-contaminated buildings in the former processing area north of the lagoon system, DNAPL contamination on-site which acts as a potential continuing source of dissolved-phase chemical compounds to groundwater. The on-site contamination of soil, sediment, surface water and ground water is present at levels well above environmental comparison values. The contaminants detected in the surface water and sediment samples collected in the southern drainage ditch are all site-attributable compounds. The contaminated surface and sub-surface soils on-site impact the surface water and groundwater through sediment transport in the surface and leaching of contaminants to the groundwater. The most significant migration pathway for groundwater is flow to the drainage ditch along the southern property boundary, and to the stormwater drainage pipe along the northern property boundary, ultimately draining into the Hackensack River. Another fraction of the groundwater discharges directly to the Hackensack River. Additionally, during the October 2002 USEPA sampling event, a seep was observed entering the Hackensack River from the *sediment southeast of the southern outfall. Without extensive remedial action, the on-site contaminants of concern would represent a potential public health concern if conditions or land use at the site change, resulting in future exposures.*

RECOMMENDATIONS

The Hackensack River is likely to be impacted by surface water run-off and groundwater discharge into the river and the potential impact on biota in the river is currently being evaluated by the NJDEP. It is recommended to the USEPA to reduce migration of on-site contaminants to the Hackensack River.

Given that groundwater present under the Standard Chlorine site discharges to the Hackensack River, hydrogeological investigations by the USEPA and/or potential responsible party(ies) to characterize the direction and extent of contaminant migration from the site to off-site areas are recommended. This distributional data will aid in the evaluation of the contribution of the Standard Chlorine site to the overall contaminant burden currently present in the Hackensack River.

As discussed in the Background section of this report, there are currently no individuals residing within a one-mile radius of the site although there are residential communities beyond the one-mile radius. As such, air monitoring designed to evaluate the impacts from site related contaminants should be conducted by the NJDEP (or by the appropriate environmental regulatory agency).

There are or will be remediation workers at the Standard Chlorine site and/or neighboring properties. Additionally, future redevelopment of the site for non-industrial purposes may significantly modify population demographics. It is recommended that air monitoring by the appropriate environmental regulatory agency be implemented during remedial activities to determine the potential health impact of airborne contaminants to both on- and off-site worker populations.

As site conditions change, public health implications and the potential for completed human exposure pathways will be reevaluated and the current designated Hazard Category will be reconsidered.

2.0 REMOVAL ACTION OBJECTIVES

The objectives of the removal/response action are identified in this section. Per the suggested outlined in the USEPA Fact Sheet for Non-Time-Critical Removal Actions under CERCLA (EPA/540/F-94/009), the statutory limits, the scope of the removal/response action, the schedule, and the planned remedial activities are discussed. Each of these components is addressed in the remainder of this section.

2.1 STATUTORY LIMITS ON REMOVAL ACTIONS

The response/removal action is being conducted as a PRP lead project. Therefore the financial statutory limit on non-time critical removal actions ($2 million) does not apply. Similarly, the 12 month temporal statutory limit for fund-financed actions (i.e., Superfund) does not apply.

2.2 DETERMINATION OF REMOVAL SCOPE

The scope of the response/removal actions is based on the attainment of several key objectives. The major objectives of the response/removal actions are as follows:

- To implement remedies that are implementable and effective components of the final remedy for the Site (to the extent practicable);
- To reduce the volume and/or the toxicity of impacted materials and environmental media to the extent practicable;
- To eliminate the potential for direct contact with constituents of interest in surface materials at the Site as a result of contact by workers or trespassers.
- To eliminate the potential for offsite migration of constituents of interest via atmospheric pathways (particulates and volatile organic vapor);
- To eliminate the potential for offsite migration of constituents of interest via overland runoff (i.e., dissolved and suspended solids surface water transport);
- To eliminate the potential for offsite migration of constituents via groundwater pathways (i.e., free phase and dissolved phase transport and discharge).

2.3 DETERMINATION OF REMOVAL SCHEDULE

The response/removal action schedule was outlined in detail in the IRAW. The schedule has been reviewed in light of ongoing Site investigation activities and is still valid as of the date of this report. Revised versions of the schedules provided in the IRAW are provided as Figures 2-1 and 2-2. Figure 2-1 is the schedule for the design and permitting tasks. Figure 2-2 is a construction schedule. The IRAW schedule has been revised to reflect actual project planning document approval dates.

2.4 PLANNED REMOVAL ACTIVITIES

Note that the planned response includes a combination of removal actions and containment options. The interim remedial activities will be discussed in terms of an interim response rather than a "non time-critical removal action." Planned removal actions consist of the following:

- Removal of containerized materials;
- Removal of near-shore river sediments;
- Removal of south ditch sediments;
- Removal of vault contents;
- Removal of septic tanks and contents;
- Removal of transformer pads;
- Containment and removal of DNAPL; and,
- Containment and removal of groundwater (as necessary to promote DNAPL removal and maintain hydraulic control within the containment system).

Other aspects of the response action consist of the following:

- Offsite treatment/disposal of containerized materials;
- Onsite consolidation and/or offsite treatment/disposal of near-shore river sediments;
- Onsite consolidation and/or offsite treatment/disposal of south ditch sediments;
- Onsite consolidation and/or offsite treatment/disposal of slurry wall spoils;

- Onsite consolidation and/or offsite treatment/disposal of piping trench spoils;
- Offsite treatment/disposal of vault contents;
- Offsite treatment/disposal of septic tank contents and tank demolition debris;
- Offsite treatment/disposal of transformer pads and associated soil;
- Offsite treatment/disposal of DNAPL; and,
- Onsite treatment of groundwater and discharge to surface water.

The potential for any future migration of constituents in environmental media will be addressed as part of the removal action via the use of containment options consisting of the use of capillary breaks, slurry walls, and steel sheet pile walls. Figure 2-3 depicts major aspects of the removal action including the steel sheet pile wall, the slurry wall, and the planned consolidation area. Note that the slurry wall alignment shown on Figure 2-3 extends south of the SCCC Site onto the Seaboard Site. This alignment was proposed in the IRAW Addendum which was submitted to the USEPA and NJDEP on March 25, 2009. The IRAW Addendum is currently under review. Table 2-1 provides a summary of the estimated volumes of material to be managed (note that DNAPL and groundwater recovery will be ongoing long-term operations and consequently, volume estimates are not provided for these media).

Note that, in addition to the preceding, sealing of certain buildings in the lagoon area will also be completed as necessary to mitigate potential release of airborne particulates. The sealing of the buildings will be conducted as a separate activity pursuant to an EPA Order. Furthermore, all regional, State, and Federal requirements relating to wetlands, endangered species, floodplains, historic preservation, coastal zone management, transportation, disposal, and permitting will be considered during the course of the detailed design phase.

3.0 REMOVAL ACTION ALTERNATIVES

The scope of the response/removal actions has been developed via continuing discussions between representatives of the NJDEP and the PRG. As a result of these discussions a viable, effective, and implementable interim response action plan has been developed which adequately addresses each of the objectives identified in the preceding section. The planned interim response action consists of multiple components, including consolidation of impacted materials, storm-water management system improvements, DNAPL recovery, installation of a barrier wall system (a fully enclosing perimeter slurry wall enhanced with a structural river frontage steel sheet pile wall), and installation of a groundwater hydraulic control system and groundwater treatment plant. Note that the barrier wall and hydraulic control components of the interim response have been designed to contain the full extent of SCCC and Diamond Site-related organic and inorganic impacts and consequently encompass the adjacent Diamond Site to the north and a portion of the adjacent Seaboard Site to the south.

Two alternatives have been identified and are described in this section: the no additional action alternative and the alternative described in detail in the IRAW and addendum. The "no additional action" alternative would consist of maintenance of the existing interim measures discussed in Section 1.2 and the September 2008 storm sewer interim measure as follows:

- Security fencing surrounding the former production area and lagoons;
- Lagoon berm height and freeboard increases;
- Geotextile/rip rap along the Hackensack River shoreline in the vicinity of the lagoon;
- Asphalt pavement overlay on existing asphalt pavement traffic;
- Asphalt paving/geotextile fabric/4" of dense graded aggregate, and 4-inch asphalt of all remaining traffic areas;
- Interim surface cover in non-traffic areas west of the railroad right-of-way with geotextile/geomembrane liner overlain with 4 inches of dense graded aggregate; and,
- Dust fence barrier along the railroad right-of-way and north fence line to isolate the impacted surface soil in the former process area;

- Storm sewer upgrades to mitigate the potential for groundwater infiltration into the sewers and backfill.

To directly address the previously stated objectives, the following actions are necessary components of the IRA:

- Installation of a physical hydraulic barrier around the entire Site (including the entire Diamond Site and a portion of the Seaboard Site);
- Operation of a hydraulic control groundwater recovery and treatment system;
- Installation of a system to recover DNAPL to remove potential source materials;
- Lagoon dewatering and backfilling to accommodate construction of a surface cover;
- Onsite consolidation (or offsite disposal) of near-shore Hackensack River sediment;
- Onsite consolidation (or offsite disposal) of South Ditch soft soils;
- Removal of transformer pad;
- Removal of septic tank contents
- Removal of materials contained in a subsurface concrete vault;
- Maintenance of the existing IRM surface covers installed at the Site.

As previously discussed, in addition to the preceding, sealing of certain buildings in the lagoon area will also be completed as necessary to mitigate potential release of airborne particulates. The sealing of the buildings will be conducted as a separate activity pursuant to an EPA Order. Each of the alternatives is briefly evaluated in terms of effectiveness, implementability, and cost, as described in the following sections.

3.1 EFFECTIVENESS

One key component of the effectiveness is the degree of protection of human and ecological receptors afforded by the response. Effectiveness may also be gauged via an assessment of compliance with Applicable, or Relevant and Appropriate Requirements (ARARs). Key aspects of these measures of effectiveness are as follows:

Short-term effectiveness

- protection of the community during the action;
- protection of workers during the action;
- environmental impacts;

Long-term effectiveness and permanence

- magnitude of residual risk;
- adequacy and reliability of controls;
- reduction of toxicity, mobility, or volume through treatment;
- degree to which treatment is irreversible;

Each of the preceding criteria for the two potential alternatives is discussed in the remainder of this subsection.

IRA W Alternative – Short-Term Effectiveness

The various components of the IRAW alternative consist of proven technologies that may be implemented in a manner that is effective on a short-term basis. The various components will eliminate potential pathways via containment and/or source removal.

Potential discharges to surface water will be controlled via either removal of impacted material (e.g., South Ditch soft soils) or via placement of engineering controls (e.g., surface covers) over impacted areas. The potential for subsurface discharge to surface water (i.e., the Hackensack River) will be eliminated via the installation of slurry and steel sheet pile walls. Hydraulic control will be exercised via groundwater pumping and treatment. This component will eliminate the potential for overtopping of the walls.

The potential for direct contact will also be controlled via the installation of cover materials. The placement of cover materials will minimize the potential for emission of fugitive dust to the atmosphere. Consolidation of impacted materials under the covers (or offsite disposal contingent upon waste classification) will minimize the potential for emission of volatile constituents.

Note that disturbance of impacted media would occur during the course of IRAW implementation. Such disturbance could result in fugitive dust and/or volatile organic emissions to the atmosphere. The potential for overland runoff of disturbed material in consolidation areas or excavation areas also exists. Transport of suspended sediment during river sediment removal could also occur. Monitoring of these potential pathways would occur during implementation and actions taken as necessary to mitigate any unacceptable condition.

Finally, the potential for offsite exposures exists in the event that accidents occur during offsite transportation and treatment/disposal. Containerized materials, vault contents, and other materials destined for offsite management, possibly including slurry wall spoils and sediments (contingent upon waste classification), will be transported offsite. Although all such transportation will be conducted in accordance with Department of Transportation requirements and all traffic laws will be obeyed, the potential for accidents always exists and this risk cannot be entirely mitigated.

Each of the remaining potential onsite release mechanisms can be readily controlled. Fugitive emissions can be controlled via administrative and engineering measures. Specifically, air monitoring is planned to ensure that atmospheric emissions that could impact Site workers or downwind receptors are monitored and controlled. In the event that action levels are exceeded, work will be stopped or engineering controls (e.g., dust suppression) will be initiated.

Earth disturbances in upland areas (i.e., consolidation areas or drainage ditches) will be accomplished in accordance with best management practices. Silt fences, straw bales, etc. will be used to prevent overland runoff of impacted material. Turbidity curtains will be employed to control the potential migration of suspended solids during river sediment disturbances. All of these control technologies are effective.

In conclusion, the IRAW remedy is considered effective over the short term. The IRAW components can be implemented in a manner that is protective of the community, workers, and the environment. In addition, the Site responses will be conducted under the auspices of CERCLA and consequently compliance with ARARs will be required. Note that sites remediated pursuant to CERCLA are exempt from permitting but must comply with the intent of applicable permits.

However, because the Site IRAW will be implemented in conjunction with the Diamond Site IRAW, and because the Diamond Site is not a CERCLA site, permits will be necessary for the majority of the remediation activities. Consequently, compliance with all ARARs associated with various permits will be assured.

No Additional Action Alternative – Short-Term Effectiveness

The majority of the Site-related potential release mechanisms have been addressed via the installation of dust fences, surface covers, and berms. However, the potential for future releases remains as a result of overland runoff, subsurface migration and discharge to the Hackensack River, and/or atmospheric emissions and downwind transport. The no additional action alternative would provide no additional control of these potential migration pathways. The no additional action alternative would not entail offsite transportation and disposal of materials. Consequently the potential for offsite release as a result of accidents would not exist under the no additional action alternative.

IRAW Alternative - Long-Term Effectiveness and Permanence

The IRAW alternative is designed to completely eliminate migration pathways and the potential for direct contact exposures. The IRAW alternative would also require that an institutional control such as a deed restriction be established. Consequently, there would be no residual risk under the IRAW alternative. In addition, the IRAW alternative is interim in nature but is intended to function as part of the potential final remedy for the Site. As a result, the IRAW alternative is expected to reduce residual risk on a long-term basis.

The controls envisioned under the IRAW are demonstrated and proven technologies based on traditional civil, environmental, and chemical engineering procedures and processes. Such controls are reliable and will be adequate to meet the intended objectives as a result of the design process. Treatability studies are underway or have been completed to determine optimum mixes for the slurry wall as well as groundwater treatment processes. As a result of the treatability studies it has been determined that adequate mixes can be achieved and that groundwater treatment can be accomplished through traditional treatment techniques (primarily reduction, precipitation, flocculation, and sorption unit operations).

A reduction in the mobility of all Site constituents will be achieved through the implementation of containment alternatives, particularly the installation of surface covers and containment walls. Toxicity will be reduced via the recovery of DNAPL, which will remove a source of groundwater impacts and result in enhanced natural attenuation and decreased concentrations over the long term. The volume of impacted material will be reduced as a result of DNAPL recovery. The reduction operation for groundwater treatment will reduce toxicity as a result of reduction of hexavalent chromium to its trivalent form. Volume increases may occur as a result of conditioning of sediments using a stabilization/solidification agent. However, such volumetric increases would be offset by the reductions in mobility and toxicity.

The primary treatment processes envisioned for the Site under the IRAW are hexavalent chromium reduction in groundwater and sorption of dissolved phase organic constituents. The chromium reduction process is essentially irreversible under environmental conditions; transformation of trivalent chromium to hexavalent chromium is atypical under most natural environmental conditions. While oxidation of trivalent chromium is thermodynamically possible, high temperatures (>200°C) or the presence of strong oxidizing agents (e.g., permanganate) or high concentrations of manganese oxide are required for oxidation to occur. Similarly, sorption is irreversible under environmental conditions. Carbon regeneration may be conducted, but such regeneration will be undertaken offsite under controlled conditions and will not result in the re-release of any Site-related organic constituents. The permanence of the IRAW alternative will ultimately be re-evaluated as a final remedy is developed for the Site.

No Additional Action Alternative - Long-Term Effectiveness and Permanence

The no additional action alternative does not address all potential migration pathways for all areas of interest at the Site and therefore, additional remedial measures have been planned as is outlined in the IRAW. Nonetheless, the actions take to date have been effective in controlling some exposure pathways and will continue to do so given the supposition that maintenance of the controls continues into the future. The measures implemented to date have been designed to address major issues of concern, and, therefore, have reduced the residual risk associated with the Site.

Assuming that maintenance continues, the measures implemented to date under the no additional action alternative are considered reliable given that they are straightforward engineering solutions (i.e., berms, surface covers, and dust fences). These measures are considered adequate to achieve the intended purposes of the individual responses.

The existing dust fences impede migration of fugitive dust from the eastern portion of the Site. The existing covers impede recharge and potential additional groundwater impact. The covers also prevent direct contact exposures, migrations of future dust, and overland runoff of impacted solids as suspended sediment to surface water bodies. Therefore, the measures implemented to date limit the mobility of constituents of interest. The existing measures have had no impact on volume or toxicity.

The measures implemented to date are purely physical responses. Consequently, no treatment occurs except that that occurs as a result of natural attenuation (e.g., reduction of hexavalent chromium in sediments and in the meadow mat or biological degradation of organic constituents). In this context, the treatment that occurs via natural attenuation is essentially irreversible.

3.2 IMPLEMENTABILITY

By definition, the no additional action alternative is readily implementable. The only requirements for the no additional action alternative are continued maintenance and possibly monitoring and reporting. These activities are readily implementable.

For the IRAW implementation, it is planned that proven and demonstrated technologies will be used for all phases of the response/removal action. The major components of the response action, and associated implementability observations are as follows:

Removal of containerized materials – This aspect of the response action is considered readily implementable. Pursuant to requests by the NJDEP, this activity will require sampling and analysis, preparation of Waste Classification Request Forms, waste classification (by the NJDEP), consolidation and overpacking of materials (as necessary), loading, offsite transportation to an appropriate facility(ies), and treatment and/or disposal.

Removal of near-shore river sediments – This process is considered readily implementable and may be accomplished by multiple straightforward tradition removal methods, including clamshell dredging, hydraulic dredging, and direct excavation at low tide using a long reach excavator. Such equipment and the required operators are readily available. Technologies necessary to control releases to surface water during the removal operations (i.e., turbidity curtains) are effective and readily implementable. Required equipment and installers of such controls are also readily available.

Removal of south ditch sediments – The south ditch sediments are exposed during much of the year and may be excavated using traditional excavation equipment. The south ditch is relatively narrow and is considered readily accessible along its entire length. Accessibility issues will be re-evaluated in the future given the progression of planned remedial responses at the adjacent Seaboard Site to the south. Equipment and personnel necessary to implement this component are readily available.

Removal of vault contents – The vault contents were previously sampled and a Waste Classification Request Form was submitted to the NJDEP based on the analytical results. The NJDEP indicated that the waste is a bulk liquid. Removal of the vault contents is readily implementable and may be accomplished via pumping or vacuuming. In fact, the removal of the vault contents was completed via pumping into drums on June 26, 2008. The drums were subsequently removed from the site on July 1, 2008 for management and incineration at the Clean Harbors facility in El Dorado, Arkansas (USEPA Identification Number ARD069748192). The vault contained bulk liquid that exhibited chlorinated benzene concentrations totaling 179 mg/Kg, a 2,3,7,8-TCDD equivalent concentration of 0.068 mg/Kg, a benzene concentration of 5.2 mg/Kg, a total polynuclear aromatic hydrocarbon concentration of 45.7 mg/Kg, and a Total Petroleum Hydrocarbon concentration of 230,000 mg/kg. Toxicity Characteristic Leaching Procedure results were below regulatory limits and the material was determined to be non-corrosive, non-ignitable, and non-reactive.

Removal of septic tanks and contents – Waste classification sampling and analysis has been completed for the septic tanks. Waste Classification Request Forms will be submitted for the septic tank contents in the near future. Removal of the tank contents and removal of the septic tanks is readily implementable. Vacuum trucks or pumps are viable options for the removal of the tank contents. Removal of the tanks themselves, which are expected to be concrete vaults, is readily implementable using traditional excavation equipment. Sampling of the septic tank solids and liquids was completed in 2008 and demonstrated the presence of PCBs at a relatively high concentration in one of the tanks (Aroclor 1232 = 74 mg/Kg). Another tank contains solids with relatively high concentrations of chlorinated benzenes (total chlorinate benzenes = 82,280 mg/Kg). RCRA Characteristic sampling and analysis of the tank solids and liquids has not been completed to date.

Removal of transformer pads – Sampling and analysis of the transformer pad has been completed to ascertain appropriate disposal options under the Toxic Substances Control Act (TSCA). A Waste Classification Request Form will be submitted for the transformer pads in the near future. Removal of the pads is readily implementable using typical excavation equipments and will likely entail the sizing of the pads using pneumatic hammers and cutting of any reinforcing steel with acetylene torches or the equivalent.

Containment and removal of dense non-aqueous phase liquids – Containment of DNAPL will be accomplished through the construction of a fully-enclosing barrier wall system comprised of slurry walls and a sheet pile wall. DNAPL physical characterization is ongoing as a component of the pre-design activities and will support the identification of appropriate recovery methods. The DNAPL is a non-viscous fluid which will enhance the ability to recover the DNAPL. The soils containing the DNAPL are relatively homogenous and this will also enhance the recoverability of the DNAPL. Recovery wells, sumps, interceptor trenches, etc. are all viable and proven technologies for the recovery of DNAPL. Note that there is a practical limit to the amount of DNAPL that can be recovered from the subsurface, however. DNAPL recovery will focus on the removal of recoverable rather than residual DNAPL.

Containment and removal of groundwater – Containment of impacted groundwater will be accomplished through the construction of a fully-enclosing barrier wall system comprised of slurry walls and a sheet pile wall. Removal of groundwater is readily implementable and may be accomplished via the installation of wells, pumps, and piping systems. A number of the existing groundwater wells at the Site could be converted to recovery wells, or new recovery wells could be installed. Groundwater pumping (and treatment) is a proven, although often ineffective, alternative. While groundwater pumping and treatment can be used to provide for hydraulic control, its effectiveness in recovering dissolved phase constituents is often limited by mass transfer phenomena and hydraulic conductivity. The primary purpose of groundwater pumping and treatment is to ensure an inward hydraulic gradient across the barrier walls and, consequently, for the purposes of hydraulic control, groundwater pumping is considered a viable and readily implementable option. Some additional benefit will be achieved via the removal of constituent mass from the subsurface over the long term. Treatability studies have been completed which demonstrate that routine unit operations such as reduction, sorption, flocculation, etc. will effectively treat the groundwater. Equipment and personnel necessary for implementation of this IRAW component are readily available.

Offsite treatment/disposal of containerized materials - It has been assumed that appropriate treatment/disposal facilities can be identified based on previous discussions with such facilities. However, the determination of final treatment/disposal facilities will be contingent upon waste characterization/classification and the receiving facility's waste acceptance plan(s). This aspect of the response action is considered implementable. Equipment and personnel required to implement this component of the IRAW are readily available.

Onsite consolidation and/or offsite treatment/disposal of near-shore river sediments - Onsite consolidation of near shore river sediments is technologically implementable via drying and conditioning of the sediments followed by placement of the material in an approved location. Equipment necessary to manage the material is readily available and free liquids may be readily treated using skid-mounted treatment equipment. One issue that could affect the implementability of this IRAW component is the approval of an Area of Contamination (AOC) policy request prepared for various media at the Site. Samples of the river sediments have been obtained to support waste classification, and the AOC policy approval is contingent upon the outcome of the waste classification process. Offsite treatment and/or disposal are also viable options assuming that appropriate disposal facilities can be identified (if necessary).

Onsite consolidation and/or offsite treatment/disposal of south ditch sediments - Any dewatering operations that may be required in association with the ditch sediment removal are also readily implementable with gravity drainage being the preferred approach. Conditioning of the sediments to enhance geotechnical properties and to bind excess moisture will be completed as necessary and is also readily implementable. In the event that the south ditch sediments are consolidated onsite in the lagoon area, it is planned that drying beds will be established. Standard civil engineering equipment such as excavators, graders, and rollers will be used if onsite consolidation is deemed appropriate based on waste classification. Such equipment and the required operator are readily available. In the event that offsite transportation and treatment/disposal is necessary (based on waste classification considerations) this aspect of the response action is considered readily implementable barring unforeseen difficulties in finding appropriate treatment/disposal facilities.

Offsite treatment/disposal of vault contents – As previously discussed, the vault contents were removed shortly after the Waste Classification process was completed by the NJDEP. The vault contents were placed in drums and were removed from the Site on July 1, 2008. The vault contents were transported to the Clean Harbors facility in El Dorado, Arkansas for incineration. This component of the IRAW has been implemented.

Offsite treatment/disposal of septic tank contents and tank demolition debris – The septic tank contents are expected to be bulk liquids that may be managed as nonhazardous waste although this will be contingent upon the results of the waste classification process. Treatment and/or disposal of this material as either hazardous or non-hazardous waste is expected to be readily implementable. Viable treatment/disposal facilities will be identified once the waste classification process is completed. It is expected that no difficulty will occur in identifying an appropriate facility.

Offsite treatment/disposal of transformer pad and associated soil – Offsite treatment and/or disposal of this material is considered readily implementable. Once waste classification is completed, appropriate facilities for offsite treatment and/or disposal will be identified. If necessary, TSCA facilities will be employed for the treatment/disposal of the transformer pads and associated soils.

Offsite treatment/disposal of dense non-aqueous phase liquids – Based on existing data, it appears that the vault contents contain higher concentrations of constituents of interest than does the DNAPL. Offsite treatment/disposal of the vault contents was found to be readily implementable and it is anticipated that no difficulties will be encountered in identifying an appropriate facility for the offsite treatment/disposal of the DNAPL. Once waste classification is complete, an appropriate facility will be identified to implement this IRAW component.

Onsite treatment of groundwater and discharge to surface water – Treatability studies have been completed using groundwater obtained from locations representative of Site-wide conditions. As a result of the treatability study, it was determined that traditional treatment technologies will be capable of treatment of the groundwater to levels below expected discharge limits. Implementation of this IRAW alternative will consist of traditional chemical engineering design processes and the use of typical primary and ancillary equipment. This component is considered readily implementable, but will require that an NJPDES permit be obtained.

3.3 COST

Although substantial sums have been expended on the interim actions completed to date, these historical costs have not been considered for the purposes of this EE/CA. Cost estimates presented herein are for future capital and operation and maintenance costs. The no additional action alternative is, by definition, inexpensive. It is estimated that approximately $20,000 per annum are expended for routine maintenance of the IRMs implemented to date at the Site. Assuming a 2 year project life and a discount factor of 5%, this equates to a present worth of $37,200 for the no additional action alternative.

The costs for implementation of the IRAW alternative are substantially greater. A detailed cost estimate displaying the projected costs for the IRAW alternative (assuming onsite consolidation of material) is provided in Table 3-1. Given that the planned IRAW is an interim remedy a 2-year project life and a discount factor of 5% were assumed for the purposes of the present worth analysis. As is shown in Table 3-1, the projected capital, annual, and present worth costs for implementation of the IRAW alternative are as follows:

- Capital Cost - $4,652,000
- Annual Cost - $ 511,000
- Present Worth - $5,163,000

4.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

In spite of the fact that substantial interim remedial measures have also been completed at the Site, the potential for future releases to the atmosphere and to the waters of the State of New Jersey exists. Consequently, as a result of these potential risks, interim remedial measures of some form are considered appropriate for the Site. A comparable assessment is included in the ATSDR Public Health Assessment.

The approach for completion of the interim response action has been developed as a result of discussions between the Group and the NJDEP. It is believed that a viable approach acceptable to all concerns parties has been developed as a result of these discussions. The IRA approach outlined in the IRAW is therefore the recommended remedial/removal action alternative.

5.0 REFERENCES

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Standard Chlorine Chemical Co., Inc., July 2008, "STANDARD CHLORINE CHEMICAL CO., INC. (SCCC) SUPERFUND SITE: Identification of Additional Potentially Responsible Party (PRP), Cooper Industries, Ltd, as successor to Thomas A. Edison, Inc.".

Standard Chlorine Chemical Co., Inc., July 2008, "STANDARD CHLORINE CHEMICAL CO., INC. (SCCC) SUPERFUND SITE, Lot 50, Identification of Additional Potentially Responsible Party (PRP), Sybron Chemicals, Inc., as successor to Tanatex Chemical Corporation".

USEPA (United States Environmental Protection Agency), August 1993. Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA. Office of Solid Waste and Emergency Response. EPA540-R-93-057.

USEPA (United States Environmental Protection Agency), December 1993. "Conducting Non-Time-Critical Removal Actions Under CERCLA." Office of Solid Waste and Emergency Response. EPA540-F-94-009.

FIGURES

0 2000 4000 FEET

N

NEW JERSEY

QUADRANGLE LOCATION

STANDARD CHLORINE CHEMICAL CO., INC.

DRWN: GLC	DATE: 5-09-07	KEY ENVIRONMENTAL INCORPORATED
CHKD: RJH	DATE: 5-09-07	
APPD: JSZ	DATE: 5-09-07	
SCALE: 1"= 2000'		

ENGINEERING EVALUATION/COST ANALYSIS
SCCC SITE
KEARNY, NEW JERSEY

REFERENCE: USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLES OF JERSEY CITY, AND WEEHAWKEN, NEW JERSEY (1967)

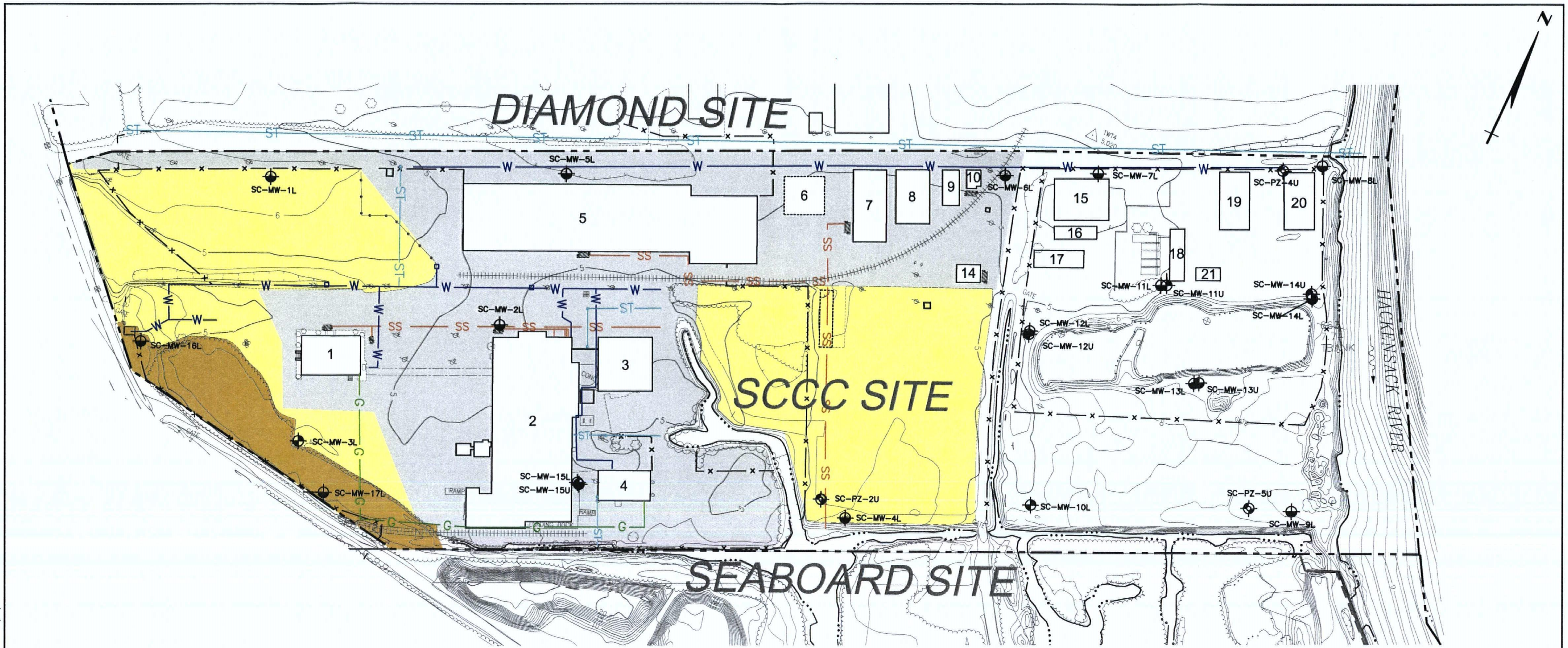
ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

SITE LOCATION MAP

PROJECT NO: 08-664

FIGURE 1-1



LEGEND

PROPERTY BOUNDARY	FORMER RAILROAD SIDING
LAGOON/STREAM	UNDERGROUND TUNNEL
FENCE LINE	1 EXISTING BUILDING/STRUCTURE AND DESIGNATION
GUARD RAIL	6 FORMER BUILDING/STRUCTURE AND DESIGNATION
TREE/BRUSH AREA	UTILITY POLE
GRAVEL/CONCRETE	SEPTIC TANK

SS — SANITARY SEWER	SC-MW-1L — LOWER ZONE MONITORING WELL
ST — STORM SEWER	INTERIM REMEDIAL MEASURE AREA ASPHALT SURFACE COVER
W — WATER LINE	INTERIM REMEDIAL MEASURE AREA SOIL SURFACE COVER
G — GAS LINE	INTERIM REMEDIAL MEASURE AREA GEOMEMBRANE/AGGREGATE SURFACE COVER
SC-PZ-4U — PIEZOMETER LOCATION	
SC-MW-15U — UPPER ZONE MONITORING WELL	

0 150 300 FEET

NOTE: UTILITY LOCATIONS ARE APPROXIMATE BASED ON BEST AVAILABLE INFORMATION.

REFERENCE:
1. EXISTING GROUND SURFACE ELEVATION CONTOURS PER AIR SURVEY, DULLES, VIRGINIA, APRIL 14, 2001. HORIZONTAL REFERENCE NEW JERSEY STATE PLANE COORDINATES (NAD 1927). VERTICAL REFERENCE NATIONAL GEODETIC VERTICAL DATUM (NGVD 1929).

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STANDARD CHLORINE CHEMICAL CO., INC.

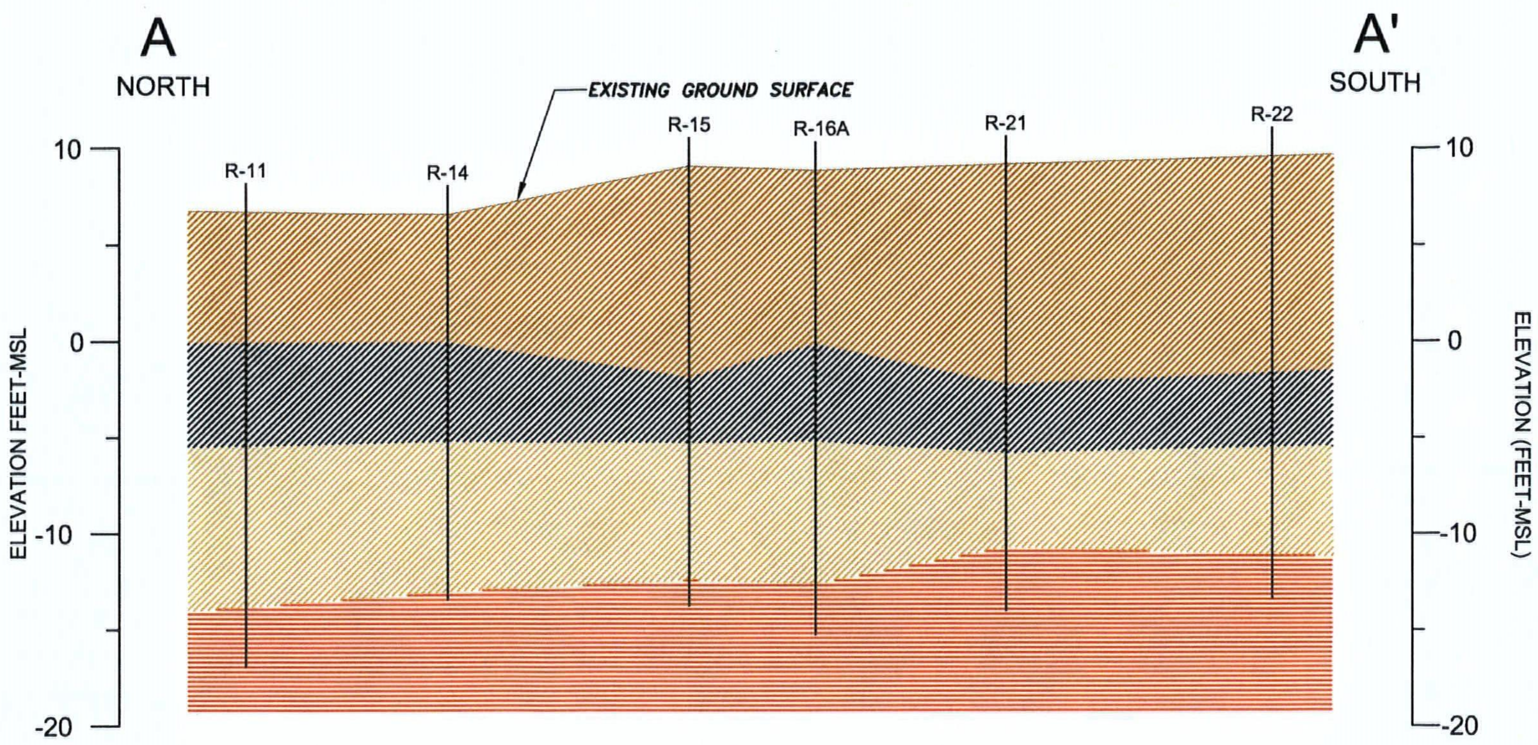
DRWN: CRJ	DATE: 01/15/08
CHKD: RJH	DATE: 01/15/08
APPD: JSZ	DATE: 01/15/08
SCALE:	AS SHOWN

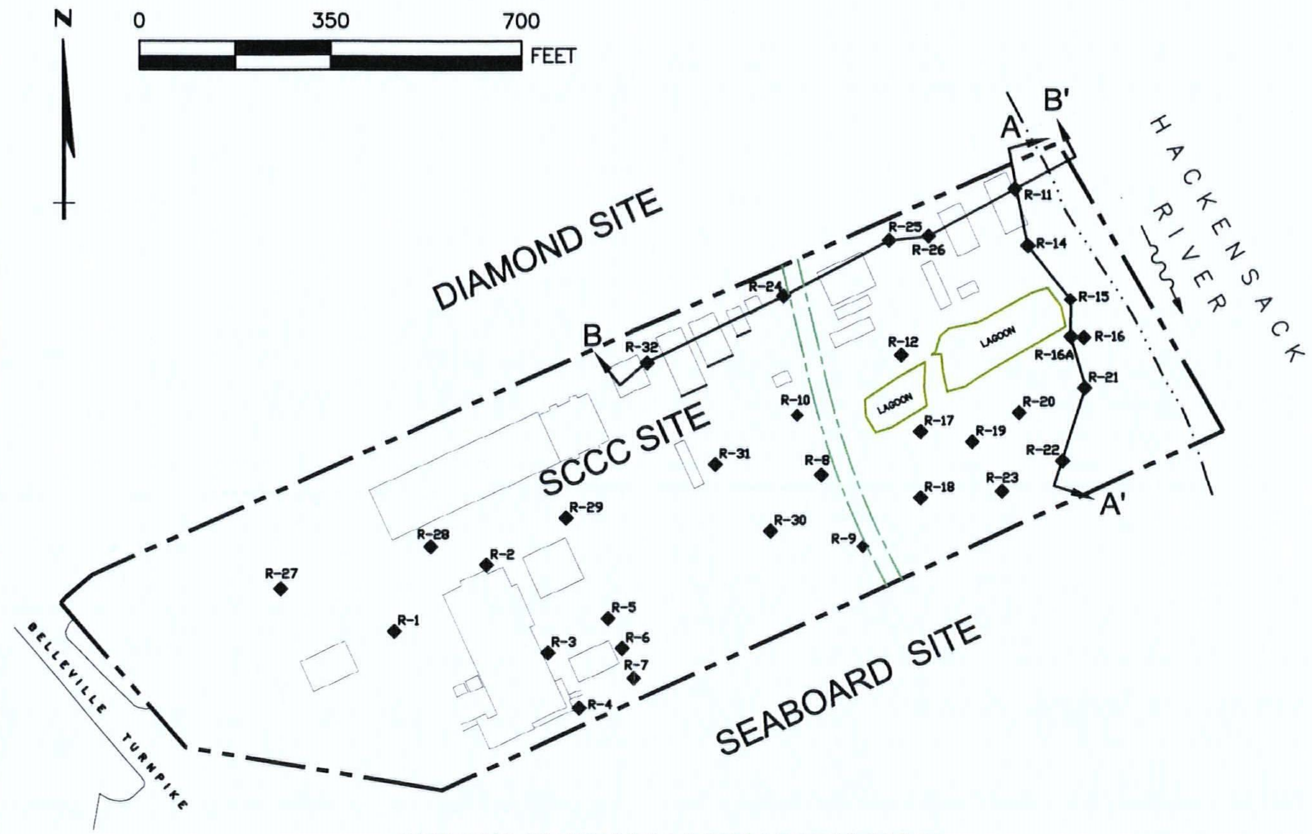
KEY ENVIRONMENTAL INCORPORATED

ENGINEERING EVALUATION/COST ANALYSIS
SCCC SITE
KEARNY, NEW JERSEY

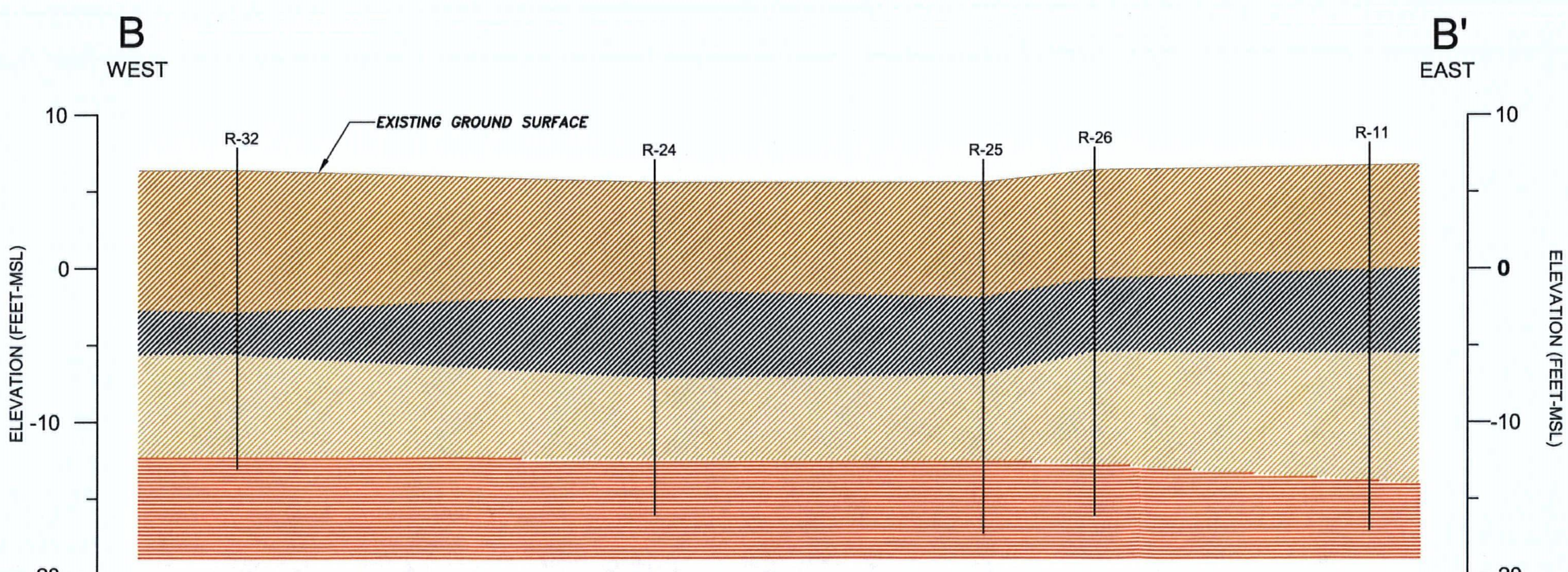
GENERAL SITE ARRANGEMENT

PROJECT NO: 08-664
FIGURE 1-2





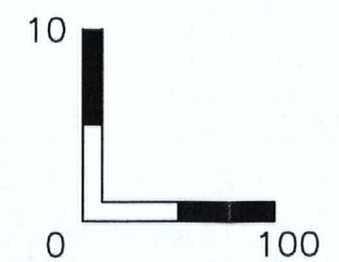
CROSS-SECTION LOCATION MAP



NOTE: GEOLOGIC CONTACTS ARE INFERRED

LEGEND

- SHALLOW (COPR SOIL) FILL MATERIAL
- MEADOW MAT
- DEEPER FINE SAND
- VARVED CLAY
- R-16A — ROST BORING LOCATION
- SITE BOUNDARY
- STRUCTURES/BUILDINGS
- RIGHT OF WAY
- R-27 — ROST BORING LOCATION
- B B' — CROSS SECTION LOCATION



SCALES IN FEET

REV #	DATE	DESCRIPTION	APPD
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REFERENCE: 1. STANDARD CHLORINE CHEMICAL COMPANY SITE SURVEY, NEGLIA ENGINEERING ASSOCIATES, JANUARY 1999. ADDITIONAL BUILDING LOCATIONS OBTAINED FROM ERM, INC. FIGURES 1, 3-1, 3-2, 3-3 AND 3-4, PROPOSED REMEDIAL ACTION PLAN, STANDARD CHLORINE SITE, KEARNY NEW JERSEY.

2. VERTICAL REFERENCE: NATIONAL GEODETIC VERTICAL DATUM (NGVD 1929).

ISSUE DATE:

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200 THIRD AVENUE
CARNEGIE, PA 15106

STANDARD CHLORINE CHEMICAL CO., INC.

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CHKD: RJH	DATE: 01/15/08
APPD: JSZ	DATE: 01/15/08
SCALE: AS SHOWN	

KEY ENVIRONMENTAL INCORPORATED

ENGINEERING EVALUATION/COST ANALYSIS
SCCC SITE
KEARNY, NEW JERSEY

GEOLOGIC CROSS-SECTIONS AND LOCATIONS

PROJECT NO: 08-664

FIGURE 1-3

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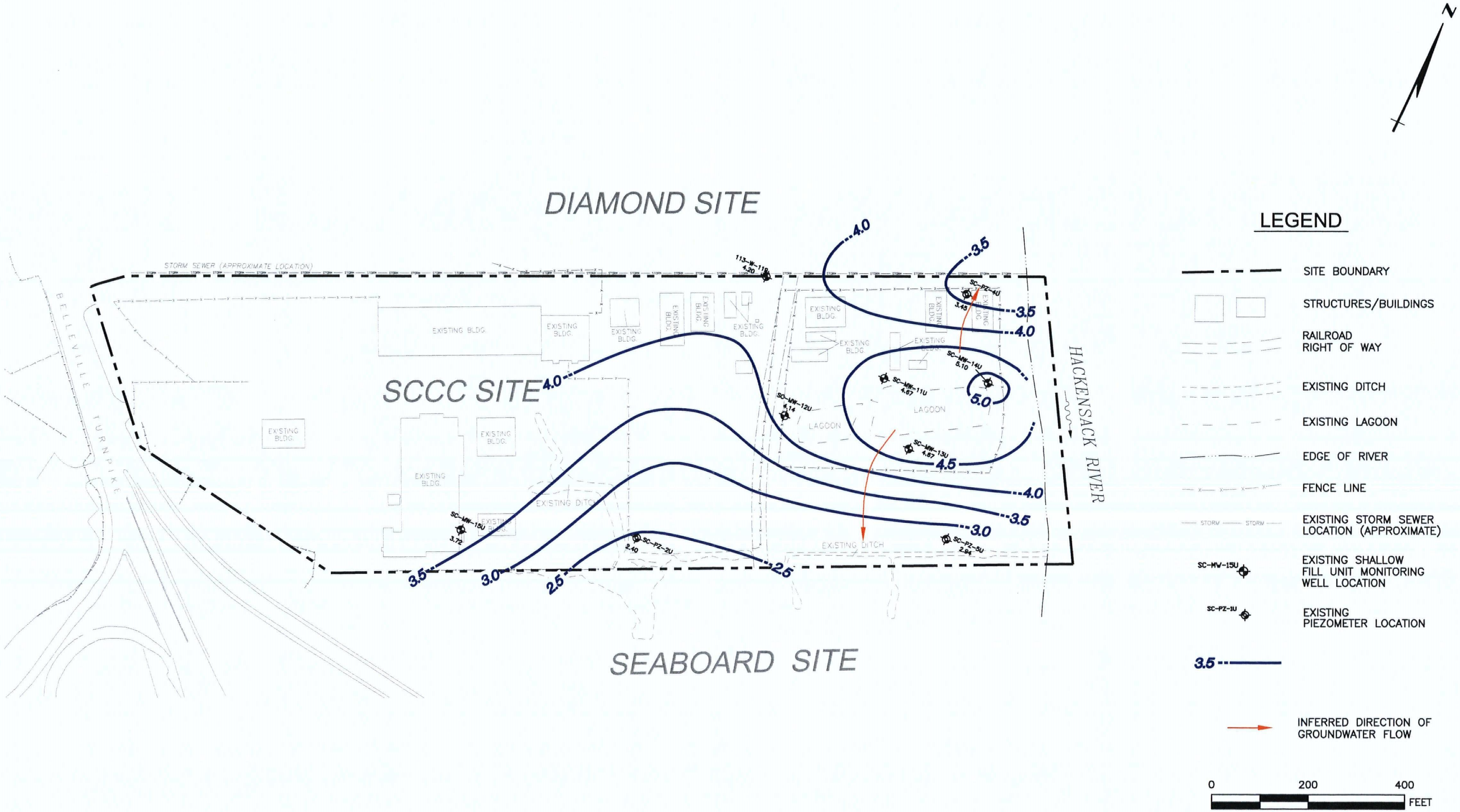

NOTE: WATER LEVELS MEASURED ON FEBRUARY 2, 1999.

REFERENCE: 1. VERTICAL REFERENCE: NATIONAL GEODETIC VERTICAL DATUM (NGVD 1929).

REV #	DATE	DESCRIPTION	APPD
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CARNEGIE, PA 15106

STANDARD CHLORINE CHEMICAL CO., INC.

DRWN: WAA	DATE: 02/29/08
CHKD: RJH	DATE: 02/29/08
APPD: JSZ	DATE: 02/29/08
SCALE:	AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

ENGINEERING EVALUATION/COST ANALYSIS
SCCC SITE
KEARNY, NEW JERSEY

POTENTIOMETRIC SURFACE MAP
FILL UNIT

PROJECT NO: 08-664
FIGURE 1-4

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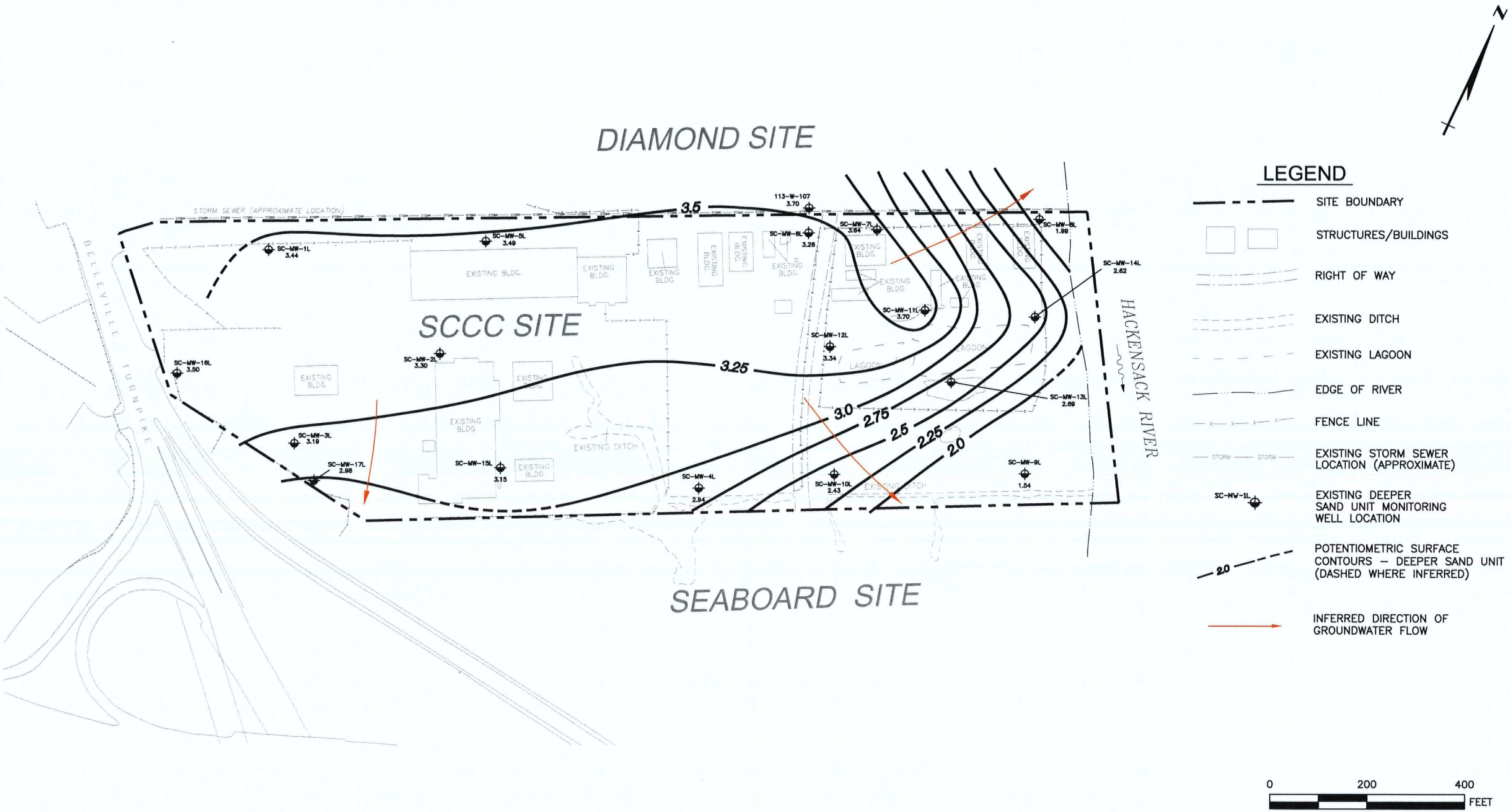

NOTE: WATER LEVELS MEASURED ON FEBRUARY 2, 1999.

REFERENCE: 1. VERTICAL REFERENCE: NATIONAL GEODETIC VERTICAL DATUM (NGVD 1929).

REV #	DATE	DESCRIPTION	APPD
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CARNEGIE, PA 15106

STANDARD CHLORINE CHEMICAL CO., INC.

DRWN: CRJ	DATE: 01/15/08
CHKD: RJH	DATE: 01/15/08
APPD: JSZ	DATE: 01/15/08
SCALE:	AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

ENGINEERING EVALUATION/COST ANALYSIS
SCCC SITE
KEARNY, NEW JERSEY

POTENTIOMETRIC SURFACE MAP
DEEPER SAND UNIT

PROJECT NO: 08-664

FIGURE 1-5

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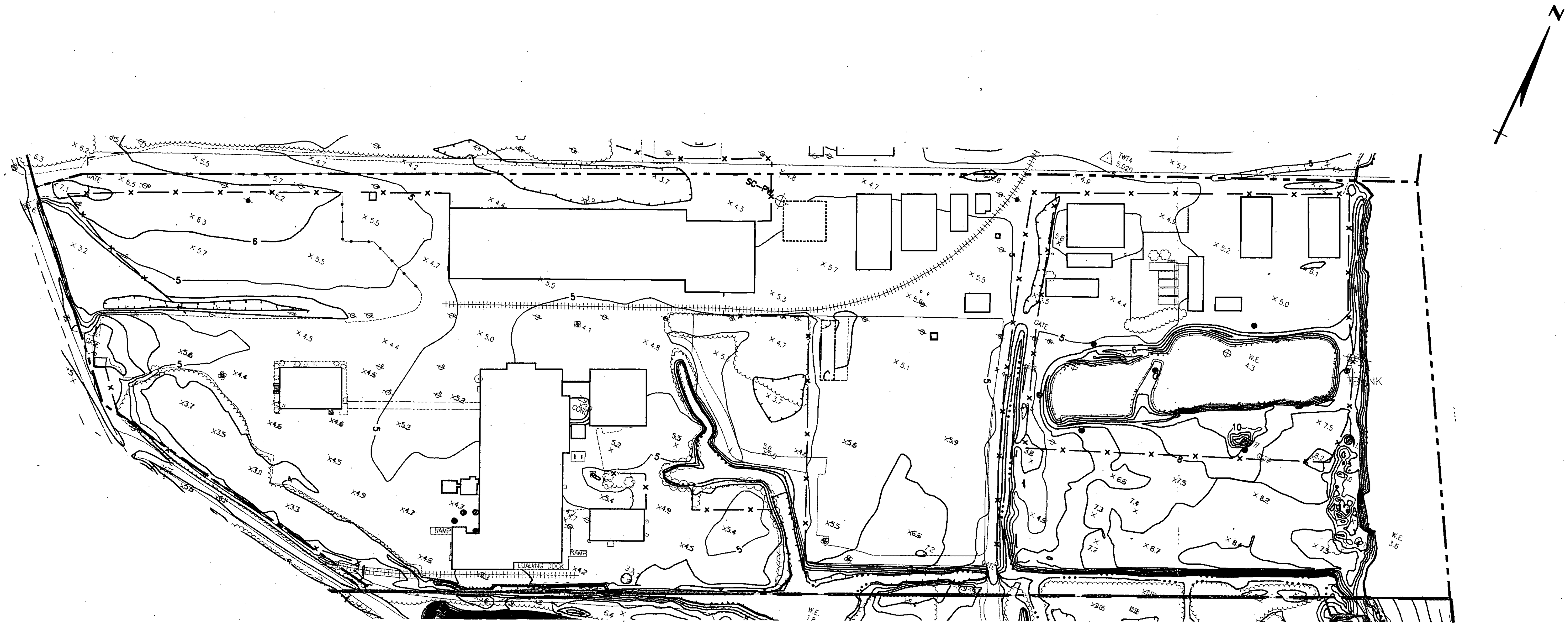


LEGEND

- EXISTING SURFACE CONTOURS
- PROPERTY BOUNDARY
- LAGOON/STREAM
- FENCE LINE
- GUARDRAIL
- TREE/BRUSH AREA
- GRAVEL/CONCRETE
- × 5.5 SPOT ELEVATION
- FORMER RAILROAD SIDING
- UNDERGROUND TUNNEL
- EXISTING BUILDING/STRUCTURE
- FORMER BUILDING/STRUCTURE
- UTILITY POLE
- SEPTIC TANK

0 150 300 FEET

STANDARD CHLORINE CHEMICAL CO., INC.

DRWN: CRJ	DATE: 01/15/08
CHKD: RJH	DATE: 01/15/08
APPD: JSZ	DATE: 01/15/08
SCALE:	AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

ENGINEERING EVALUATION/COST ANALYSIS
SCCC SITE
KEARNY, NEW JERSEY

SITE TOPOGRAPHY

PROJECT NO: 08-664

FIGURE 1-6

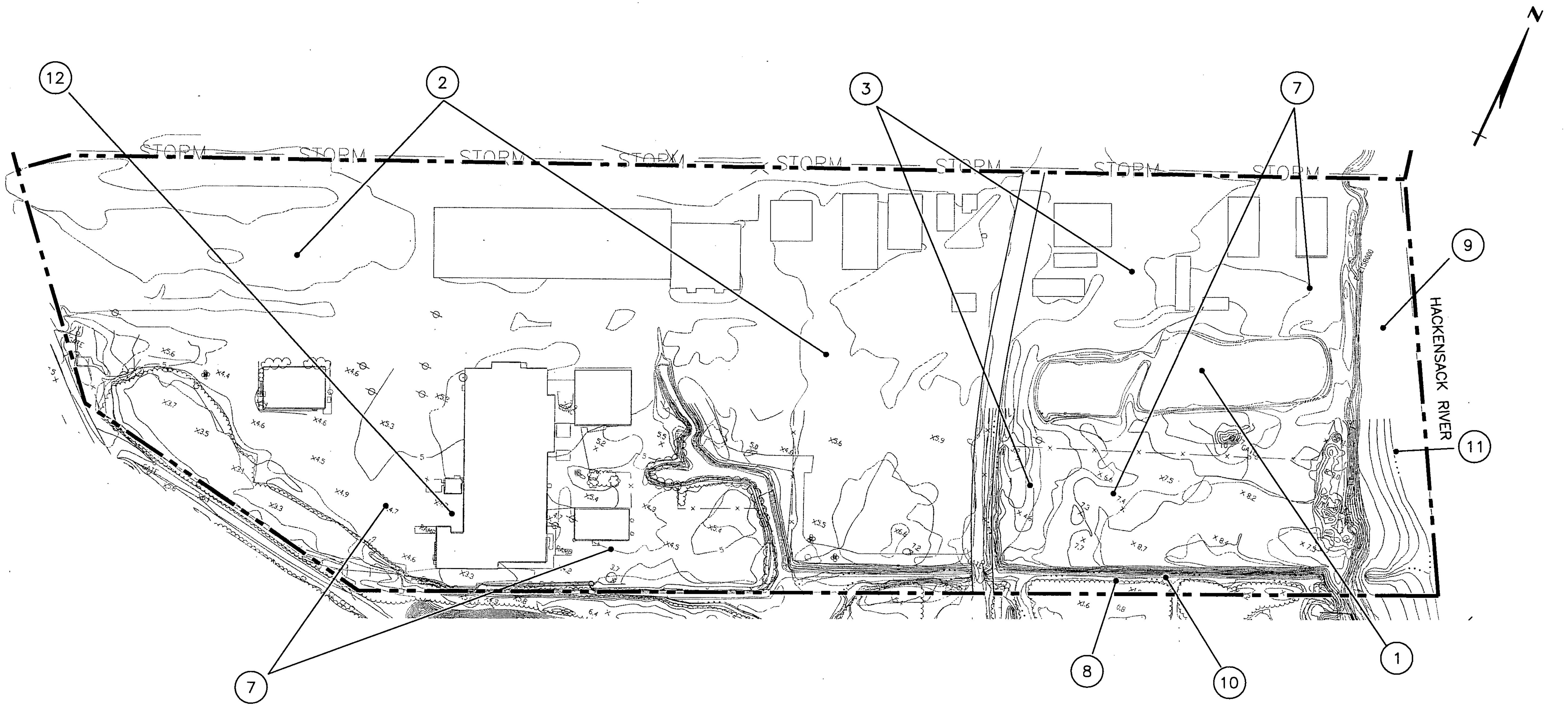
REV #	DATE	DESCRIPTION	APPD
3			
2			
1			

REFERENCE:

1. EXISTING GROUND SURFACE ELEVATION CONTOURS PER AIR SURVEY, DULLES, VIRGINIA, APRIL 14, 2001. HORIZONTAL REFERENCE NEW JERSEY STATE PLANE COORDINATES (NAD 1927). VERTICAL REFERENCE NATIONAL GEODETIC VERTICAL DATUM (NGVD 1929).

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106



AREA OF CONCERN SUMMARY	
NUMBER	DESCRIPTION
1	LAGOON SOLIDS
2	WESTERN AREA SOIL
3	EASTERN AREA SOIL
4	SHALLOW FILL UNIT GROUNDWATER
5	DEEPER SAND UNIT GROUNDWATER
6	BEDROCK GROUNDWATER
7	DENSE NON-AQUEOUS PHASE LIQUID
8	DRAINAGE DITCH SURFACE WATER
9	HACKENSACK RIVER SURFACE WATER
10	DRAINAGE DITCH SEDIMENT
11	HACKENSACK RIVER SEDIMENT
12	TRANSFORMER AREA

0 150 300 FEET

* SUBSURFACE AREAS OF CONCERN.

STANDARD CHLORINE CHEMICAL CO., INC.

DRWN: WAA	DATE: 02/26/08
CHKD: RJH	DATE: 02/26/08
APPD: JSZ	DATE: 02/26/08
SCALE:	AS SHOWN

KEY ENVIRONMENTAL INCORPORATED

ENGINEERING EVALUATION/COST ANALYSIS
SCCC SITE
KEARNY, NEW JERSEY

AREAS OF CONCERN

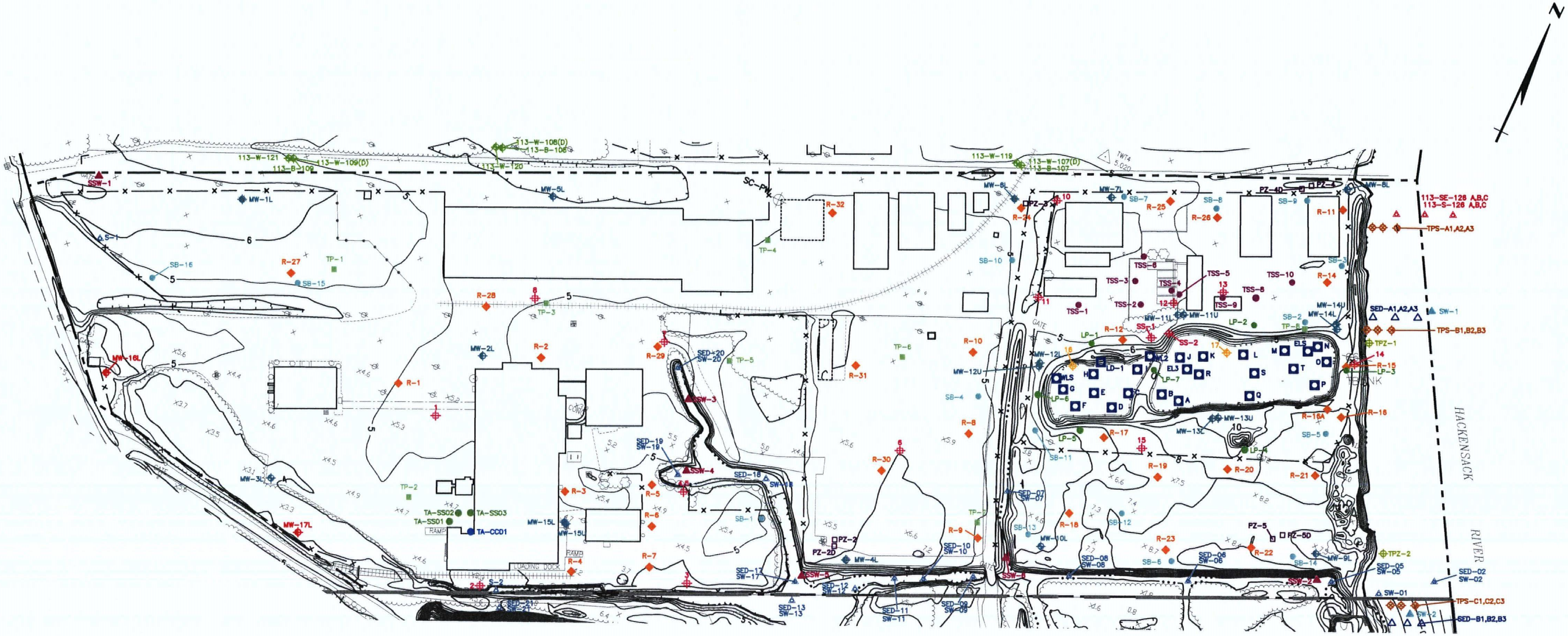
PROJECT NO: 08-664
FIGURE 1-7

REV #	DATE	DESCRIPTION	APPD
3			
2			
1			

REFERENCE:

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106



LEGEND

— - - —	PROPERTY BOUNDARY
— • • • —	LAGOON/STREAM
— x — x —	FENCE LINE
+++++++	FORMER RAILROAD SIDING
- · - · -	UNDERGROUND TUNNEL
—•—•—	GUARDRAIL
	BUSH / TREELINE
	EXISTING BUILDING/STRUCTURE
	FORMER BUILDING/STRUCTURE
	UTILITY POLE
x 5.5	SPOT ELEVATION

3	SURFACE SOIL SAMPLE LOCATION (WESTON)
SS-1	SURFACE SOIL SAMPLE LOCATION (WESTON)
B,LD-1,WL2,ELS	LAGOON SAMPLES LOCATION (WESTON)
LP-2	SOIL BORING SAMPLE LOCATION (WESTON)
SB-1	SOIL BORING SAMPLE LOCATION (ERM)
TSS-1	TANK SURFACE SOIL SAMPLE LOCATION (WESTON)
TA-SS01	SOIL SAMPLE LOCATION (KEY)
TA-CC01	CONCRETE CHIP SAMPLE LOCATION (KEY)
TP-1	TEST PIT LOCATION (WESTON)
R-1	RAPID OPTICAL SCREENING TOOL BORING LOCATION (KEY)

MW-17L	MONITORING WELL LOCATION (KEY)
PZ-3	SHALLOW PIEZOMETER LOCATION
PZ-3D	DEEP PIEZOMETER LOCATION
113-W-121	SHALLOW MONITORING WELL LOCATION (BROWN & CALDWELL)
113-W-107D	DEEP MONITORING WELL LOCATION (BROWN & CALDWELL)
113-B-107	SOIL BORING (BROWN & CALDWELL)
MW-14U	SHALLOW MONITORING WELL/SOIL BORING LOCATION (WESTON)
MW-14L	DEEP MONITORING WELL/SOIL BORING LOCATION (WESTON)
TPZ-1	TEMPORARY MONITORING WELL LOCATION (WESTON)

TPS-A1,A2,A3	SEDIMENT SAMPLE LOCATION (ESI)
SED-B1,B2,B3	SEDIMENT SAMPLE LOCATION (ERM)
SW-1	SURFACE WATER SAMPLE LOCATION (ERM)
SSW-1	SURFACE WATER / SEDIMENT SAMPLE LOCATION (WESTON)
SED-18 SW-18	SEDIMENT AND SURFACE WATER SAMPLE LOCATION (USEPA)
113-SE-126 A,B,C 113-S-126 A,B,C	SURFACE WATER AND SEDIMENT SAMPLE LOCATION (BROWN & CALDWELL)
18	SEDIMENT SAMPLE LOCATER (E.C. JORDON)

0 150 300 FEET

REV #	DATE	DESCRIPTION	APPD
△			
△			
△			

REFERENCE:

1. EXISTING GROUND SURFACE ELEVATION CONTOURS PER AIR SURVEY, DULLES, VIRGINIA, APRIL 14, 2001. HORIZONTAL REFERENCE NEW JERSEY STATE PLANE COORDINATES (NAD 1927). VERTICAL REFERENCE NATIONAL GEODETIC VERTICAL DATUM (NGVD 1929).

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106

STANDARD CHLORINE CHEMICAL CO., INC.

DRWN: WAA	DATE: 07/07/08
CHKD: RJH	DATE: 07/07/08
APPD: JSZ	DATE: 07/07/08
SCALE: AS SHOWN	

KEY ENVIRONMENTAL INCORPORATED

ENGINEERING EVALUATION/COST ANALYSIS
SCCC SITE
KEARNY, NEW JERSEY

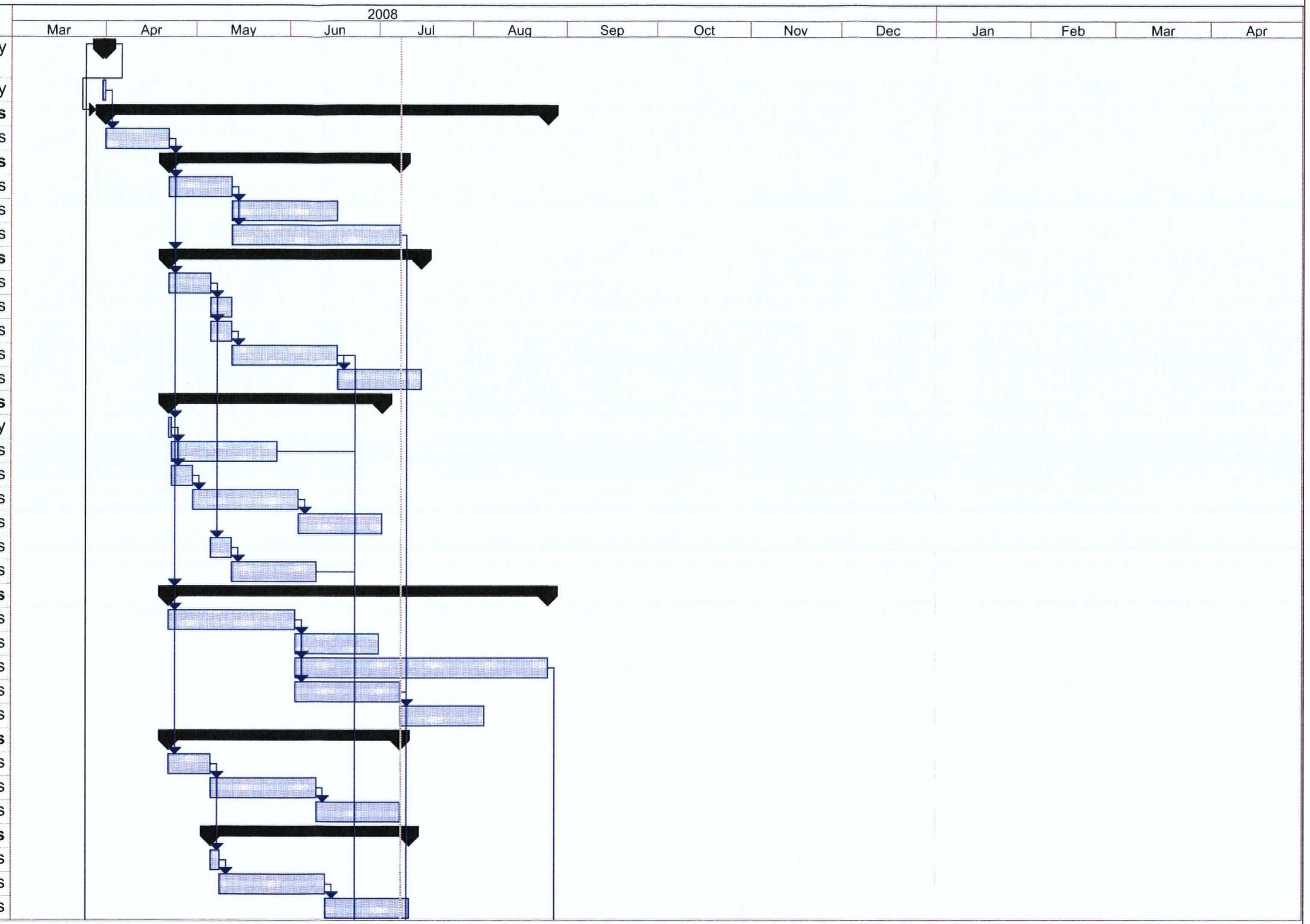
HISTORICAL SAMPLE LOCATIONS

PROJECT NO: 08-664

FIGURE 1-8

FIGURE 2-1
INTERIM RESPONSE ACTION DESIGN AND PERMITTING SCHEDULE
ENGINEERING EVALUATION/COST ANALYSIS
STANDARD CHLORINE CHEMICAL COMPANY SITE
KEARNY, NEW JERSEY

ID	Task Name	Duration
1	**Interim Response Action Workplan (IRAW) for SCCC and Diamond Sites**	1 day
2	NJDEP Final Approval of IRAW	1 day
3	**Design Data Acquisition**	**105 days**
4	**Contractor Procurement/Mobilization**	15 days
5	**Hydraulic Control System**	**55 days**
6	Groundwater Sampling	15 days
7	Groundwater Analysis	25 days
8	Bench-ScaleTesting/Analyses	40 days
9	**DNAPL Recovery System**	**60 days**
10	Test Borings	10 days
11	Geotechnical Testing	5 days
12	DNAPL Sampling	5 days
13	Laboratory Analyses (DNAPL)	25 days
14	Preparation of Waste Classification Forms	20 days
15	**Lagoon Dewatering and Backfill**	**51 days**
16	Surface Water Sample Collection	1 day
17	Laboratory Analysis (Surface Water)	25 days
18	Solids Sample Collection	5 days
19	Laboratory Analyses (Lagoon Solids)	25 days
20	Preparation of Waste Classification Form	20 days
21	Test Borings	5 days
22	Geotechnical Testing	20 days
23	**Barrier Wall**	**90 days**
24	Test Borings	30 days
25	Geotechnical Testing	20 days
26	Slurry Mix Evaluations	60 days
27	Laboratory Analysis (Future Slurry Wall Spoils)	25 days
28	Preparation of Waste Classification Form	20 days
29	**Additional Waste Classification Determination**	**55 days**
30	Sample Collection (Septic Tanks, Transformer Pad)	10 days
31	Laboratory Analysis	25 days
32	Preparation of Waste Classification Forms	20 days
33	**Sediment Sampling (Near Shore and Drainage Ditch)**	**48 days**
34	Sample Collection	3 days
35	Sample Analysis	25 days
36	Preparation of Waste Classification Forms	20 days

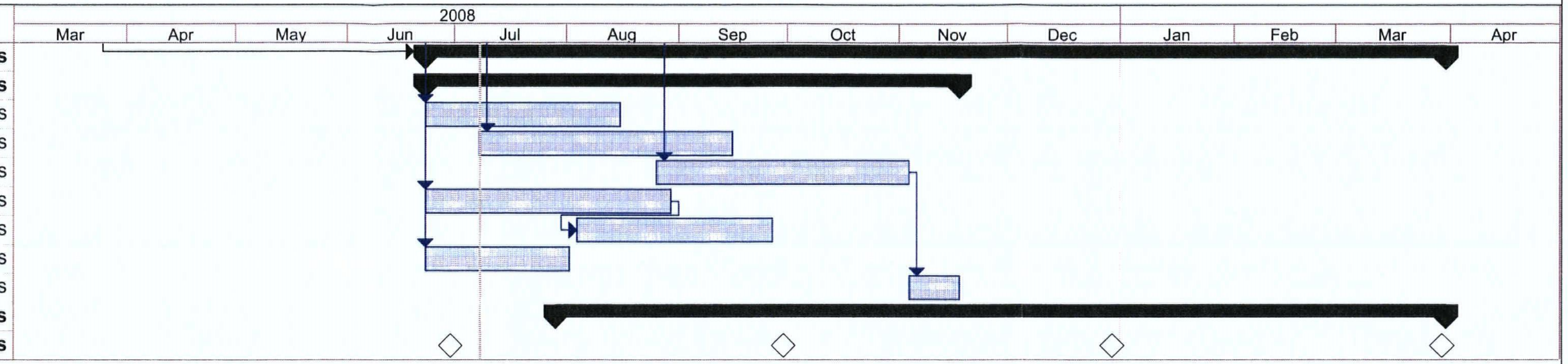


Project: \\pgh1\projects\Kearny Peninsula\1F - 2008 Proje
Date: 7/8/2008

Task | Milestone | Summary | Rolled Up Milestone

FIGURE 2-1
INTERIM RESPONSE ACTION DESIGN AND PERMITTING SCHEDULE
ENGINEERING EVALUATION/COST ANALYSIS
STANDARD CHLORINE CHEMICAL COMPANY SITE
KEARNY, NEW JERSEY

ID	Task Name	Duration
37	**Design and Permitting**	**201 days**
38	**Design Activities**	**106 days**
39	DNAPL Recovery System Design	40 days
40	Hydraulic Control System Design	50 days
41	Barrier Wall Design	50 days
42	Interim Surface Cover Design	50 days
43	Surface Water Outfalls and River Sediments Design	40 days
44	Lagoon Dewatering and Backfill Design	30 days
45	Comprehensive Construction Drawings and Specifications	10 days
46	**Permitting Activities**	**175 days**
78	**Progress Reports**	**195 days**

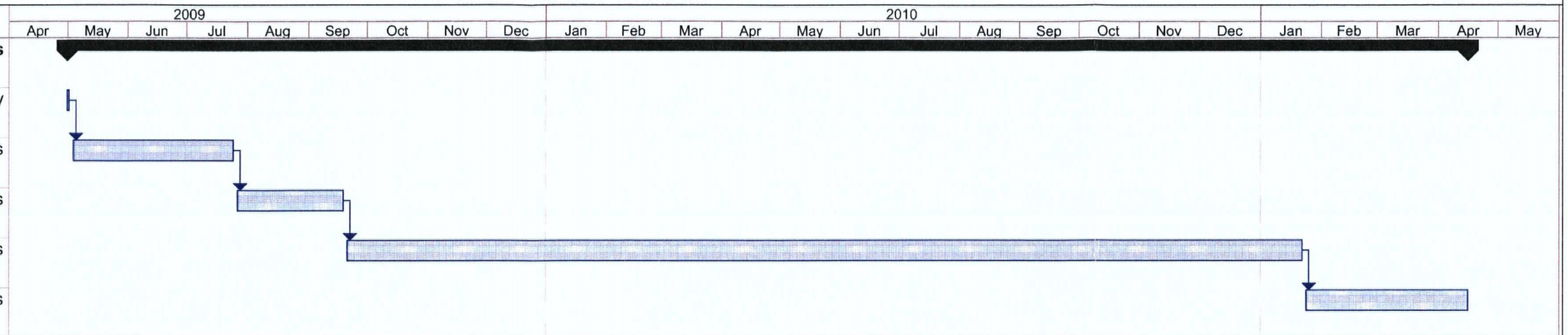


Project: \\pgh1\projects\Kearny Peninsula\1F - 2008 Proje
Date: 7/8/2008

Task | Milestone | Summary | Rolled Up Milestone

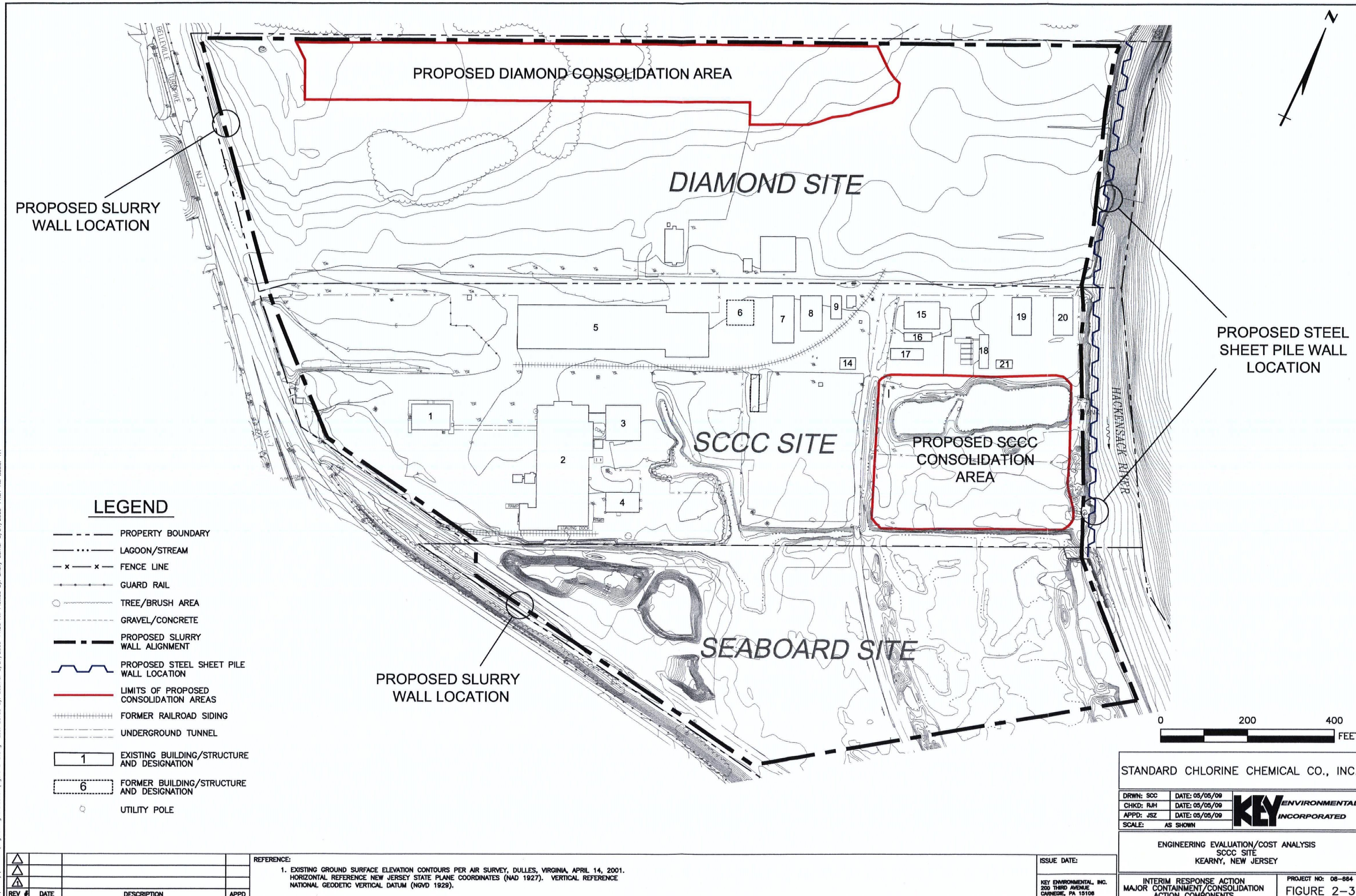
FIGURE 2-2
INTERIM RESPONSE ACTION CONSTRUCTION SCHEDULE
ENGINEERING EVALUATION/COST ANALYSIS
STANDARD CHLORINE CHEMICAL COMPANY SITE
KEARNY, NEW JERSEY

ID	Task Name	Duration
1	**Interim Response Action Construction**	**511 days**
2	Design/Permitting Approval	1 day
3	Construction Procurement/Selection	60 days
4	Mobilization	40 days
5	Construction	350 days
6	Interim Response Action Report	60 days



Project: \\pgh1\projects\Kearny Peninsula\1F - 2008 Proje
Date: 7/8/2008

Task | Milestone | Summary | Rolled Up Milestone


PROPOSED DIAMOND CONSOLIDATION AREA
DIAMOND SITE
SCCC SITE
SEABOARD SITE
PROPOSED SCCC CONSOLIDATION AREA
PROPOSED SLURRY WALL LOCATION
PROPOSED SLURRY WALL LOCATION
PROPOSED STEEL SHEET PILE WALL LOCATION
HACKENSACK RIVER
BELLEVILLE TURNPIKE
NJ-7
N
1
2
3
4
5
6
7
8
9
14
15
16
17
18
19
20
21
LEGEND
PROPERTY BOUNDARY
LAGOON/STREAM
FENCE LINE
GUARD RAIL
TREE/BRUSH AREA
GRAVEL/CONCRETE
PROPOSED SLURRY WALL ALIGNMENT
PROPOSED STEEL SHEET PILE WALL LOCATION
LIMITS OF PROPOSED CONSOLIDATION AREAS
FORMER RAILROAD SIDING
UNDERGROUND TUNNEL
1 EXISTING BUILDING/STRUCTURE AND DESIGNATION
6 FORMER BUILDING/STRUCTURE AND DESIGNATION
UTILITY POLE
0
200
400
FEET
REV #
DATE
DESCRIPTION
APPD
REFERENCE:
1. EXISTING GROUND SURFACE ELEVATION CONTOURS PER AIR SURVEY, DULLES, VIRGINIA, APRIL 14, 2001. HORIZONTAL REFERENCE NEW JERSEY STATE PLANE COORDINATES (NAD 1927). VERTICAL REFERENCE NATIONAL GEODETIC VERTICAL DATUM (NGVD 1929).
ISSUE DATE:
KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15106
STANDARD CHLORINE CHEMICAL CO., INC.
DRWN: SCC
DATE: 05/05/09
CHKD: RJH
DATE: 05/05/09
APPD: JSZ
DATE: 05/05/09
SCALE: AS SHOWN
KEY ENVIRONMENTAL INCORPORATED
ENGINEERING EVALUATION/COST ANALYSIS
SCCC SITE
KEARNY, NEW JERSEY
INTERIM RESPONSE ACTION
MAJOR CONTAINMENT/CONSOLIDATION
ACTION COMPONENTS
PROJECT NO: 08-664
FIGURE 2-3

TABLES

TABLE 1-1

**PRINICIPAL HISTORICAL RI AND IRM ACTIVITIES
SCCC SITE[1] KEARNY, NEW JERSEY**

Date	Activity	Principal Documents
1983-1984	Hydrogeologic Investigation	*Hydrogeologic Investigation, Standard Chlorine Chemical Company, Inc., Kearny, New Jersey* (Weston, January 1984).
1985	Phase II Dioxin Investigation	*Phase II Dioxin Site Investigation, Final Report, Standard Chlorine Chemical Company, Inc., Kearny, New Jersey,* for NJDEP/EPA (E.C. Jordan, Inc. 1985).
1985-1988	Stage 1, 2, and 3 Dioxin Investigations	*Sampling and Analysis of Potentially Dioxin-Contaminated Materials in Waste Lagoons, Standard Chlorine Chemical Company, Stage I Analysis Report* (Weston, September 1987)*; and* *Sampling and Analysis of Potentially Dioxin-Contaminated Materials in Waste Lagoons, Stage II and III* (Weston, May 1988).
1989-1990	Interim Remedial Measures	*Draft Interim Measures Work Plan, Standard Chlorine Chemical Co., Inc, Kearny, New Jersey* (Weston, November 1989)*;and* *Final IRM Workplan* (Weston, February 1990).
1991	Chromium IRMs[2]	*Interim Remedial Measures Work Plan* (French & Parrello, 1991).
1990-1993	Remedial Investigation and Supplemental Remedial Investigation	*Remedial Investigation Work Plan for the Standard Chlorine Chemical Company, Kearny, New Jersey* (Weston, May 1990) as modified by August 1990 addendum; *Supplemental Workplan, RI* (Weston, August 1992); *Draft Remedial Investigation for the Standard Chlorine Chemical Company, Inc. and Standard Naphthalene Products Inc. Properties, Kearny, New Jersey* (Weston, May 1993).
1995-1997	Focused Remedial Investigation	*Focused Remedial Investigation (FRI) Work Plan, Standard Chlorine Chemical Company Inc. and Standard Naphthalene Products Inc. Site, Kearny, New Jersey* (ERM, December 1995); *Focused Remedial Investigation (FRI) Report, Standard Chlorine Chemical Company, Inc. and Standard Naphthalene Products, Inc. Site, Kearny, New Jersey* (ERM, Inc., January 1997).

TABLE 1-1

PRINICIPAL HISTORICAL RI AND IRM ACTIVITIES SCCC SITE[1] KEARNY, NEW JERSEY

Date	Activity	Principal Documents
1996	Production Well Closure	*Workplan for Production Well Closure* (ERM., December 1996).
1997	Proposed Remedial Action Plan	*Proposed Remedial Action Plan, Standard Chlorine Chemical Co. Inc. and Standard Naphthalene Products, Inc. Site, Kearny, New Jersey* (ERM January 1997).
1997-1999	Supplemental Remedial Investigation	*Supplemental Remedial Investigation Report, Standard Chlorine Chemical Company, Kearny, New Jersey* (Key Environmental, Inc., April 1999).
1999	Remedial Action Work Plan	*Conceptual Remedial Action Workplan, Standard Chlorine Chemical Company, Inc., Kearny, New Jersey* (Enviro-Sciences, Inc., October 1999);
2000	Remedial Action, Containerized Materials, SCCC Site	*Remedial Action Workplan, Standard Chlorine Chemical Company Site* (Enviro-Sciences, Inc., June 5, 2000); *Letter to NJDEP (Maria Franco-Spera) re: Characterization of Containerized Materials* (Enviro-Sciences, Inc., October 23, 2000).
2000	Soil/Sediment Sampling and Analysis	*Letter to NJDEP (Maria-Franco-Spera)* (Enviro-Sciences, Inc., October 23, 2000).
2000	Septic Tank Closure (NJPDES-DGW) IRM,	*Letter to NJDEP (Kevin Marlowe)* (Enviro-Sciences, Inc., August, 2000).
2000	Remedial Action, Baseline Ecological Evaluation, IRM for Northern Outfall	*Remedial Action Workplan, Standard Chlorine Chemical Company, Inc., Kearny, New Jersey* (Enviro-Sciences, Inc., November 2000).
2002	Surface Water and Sediment Sampling	*Sampling Report for the Standard Chlorine Site* (United States Environmental Protection Agency, 2002).
2003	Interim Remedial Measures	*Interim Remedial Measures Workplan, Standard Chlorine Chemical Co., Inc., Kearny, New Jersey* (Key Environmental, Inc., July 2003).
2004	Interim Response Action	*Draft Interim Response Action Workplan (IRAW) – Standard Chlorine Chemical Company Site and Diamond Site* (Key Environmental, Inc., March 2004).
2004	Lead and Asbestos Buildings Survey	*Pre-Demolition Asbestos and Lead Building Surveys, Standard Chlorine Chemical Company Site and Diamond Site* (Omega Environmental Services, Inc., March 2004).

TABLE 1-1

PRINICIPAL HISTORICAL RI AND IRM ACTIVITIES
SCCC SITE[1] KEARNY, NEW JERSEY

Date	Activity	Principal Documents
2004	Asbestos Management and Building Demolition	*Workplan for Phase I Asbestos Management and Select Building Demolition, SCCC Site* (Key Environmental, Inc., June 2004).
2004	Wetlands Delineation	*Wetlands Delineation Report for Standard Chlorine Chemical Company and Former Diamond Sites* (Princeton Hydrologic, L.L.C., September 2004).
2004	Pre-Design Investigation Workplan	*Pre-Design Investigation Workplan, Volume 1 of 2, Standard Chlorine Chemical Company Site and Former Diamond Site* (Key Environmental, Inc., October 2004).
2004	Solidification Treatability Study Workplan	*Solidification Treatability Study Work Plan, Standard Chlorine Chemical Company Site* (Key Environmental, Inc., October 2004).
2004	Aerial Topographic Survey	Topographic Base Map (Air Survey, Dulles, VA. April 14, 2001).
2005	Asbestos Removal, Waste Classification, Demolition, Disposal	*Work Plan for Dilapidated Non-Process Building Demolition, Standard Naphthalene Products Co., Inc., Finished Goods Area* (Key Environmental, August 2005).
2005	Scope of Work – Supplemental RI	Electronic Mail to NJDEP (Gary Lipsius) (Langan Engineering and Environmental Services, Inc., July 21, 2005).
2005	Pre-Design Investigation Workplan	*Pre-Design Investigation Workplan, Volume 2 of 2, Appendices A-D, Standard Chlorine Chemical Company Site and Former Diamond Site* (Key Environmental, Inc., December 2005).
2006	Interim Response Action Work Plan	*Interim Response Action Workplan (IRAW).* (Key Environmental, Inc. June 2006.)
2006	Numerical Groundwater Modeling	*Groundwater Flow and Transport Model and Barrier Wall Evaluation, Standard Chlorine Chemical Company, Inc. Site and Diamond Shamrock Site* (GeoTrans, Inc., June 23, 2006)
2006	Request for Use of USEPA Area of Contamination Policy	Letter to NJDEP *(Chris Kanakis and Frank Faranca) re*: Use of USEPA Area of Contamination Policy (Key Environmental, Inc., July 3, 2006).
2006	Proposal for Use of EPA Area of Contamination (AOC) Policy	*AOC Proposal for Standard Chlorine Chemical Co., Inc. Site "SCC Site"* (Langan, October 2006)

TABLE 1-1

PRINICIPAL HISTORICAL RI AND IRM ACTIVITIES
SCCC SITE[1] KEARNY, NEW JERSEY

Date	Activity	Principal Documents
2006	Vault Content Sampling /Waste Classification Determination	Letter to NJDEP with attached "Request for Waste Classification Determination (Form HWM-009)" (Langan Engineering and Environmental Services, Inc., October 25, 2006).
2007	Interim Response Action Workplan	*Interim Response Action Workplan (IRAW) for SCCC Site and Diamond Sites* (Key Environmental, Inc., May 2007).
2007	Interim Response Action Workplan Addendum	*Interim Response Action Workplan (IRAW) Addendum, Responses to NOV Issues and Proposed Revisions,* Standard *Chlorine Chemical Company Site and Diamond Site* (Key Environmental, Inc., November 16, 2007).
2008	Phase II Supplemental Remedial Investigation Workplan	*Phase II Supplemental Remedial Investigation Workplan, Standard Chlorine Chemical Company Site* (Key Environmental, Inc., March 2008).
2008	Sampling and Analysis Plan for Containerized Materials	*Site-Specific Sampling and Analysis Plan for Containerized Materials, Standard Chlorine Chemical Company Site, Kearny, New Jersey* (Key Environmental, Inc., April 2008)
2008	Resubmittal of Waste Classification Request For Vault Contents	*Waste Classification Request, Standard Naphthalene Products Co., Inc. Property, Standard Chlorine Chemical Co., Inc. Site, Kearny, New Jersey* (Key Environmental, Inc. April 2008)
2008	Additional Information Pertaining to the Waste Classification Request For Vault Contents	*Waste Classification Request – Vault Contents Standard Naphthalene Products Co., Inc. (SNP) Property, Standard Chlorine Chemical Co., Inc. Site, Kearny, New Jersey* (Key Environmental, Inc. June 2008)
2008	Removal of the Vault Contents	*Removal of Vault Contents, Standard Chlorine Chemical Company (SCCC) Site* (Key Environmental, Inc. August 2008)

[1] Since 1989, work at the SCCC Site has been conducted under the October 20, 1989 Administrative Consent Order entered into by NJDEP and Standard Chlorine Chemical Co., Inc. (The SCCC ACO). In October 1993, the PRG undertook responsibility for performance of work under the SCCC ACO.

[2] Some work at the SCCC Site has been conducted under an Administrative Consent Order dated April 17, 1990 entered by NJDEP with Occidental Chemical Corporation (OCC) and Chemical Land Holdings, (CLH) Inc. (now Tierra) relating to COPR (the "Diamond ACO"). Maxus historically had responsibility for overseeing work under the Diamond ACO for OCC, as successor to Diamond Shamrock Chemicals Company.

TABLE 2-1

INTERIM RESPONSE ACTION VOLUME ESTIMATES
SCCC SITE - KEARNY, NEW JERSEY

Interim Response Action Material	Estimated Volume
Containerized Materials (Liquid)	~ 1,600 Gallons
Containerized Materials (Solid)	~ 95 Cubic Yards
Near-Shore Hackensack River Sediments	~ 3,400 Cubic Yards
South Ditch Soft Soils	~ 1,400 Cubic Yards
Slurry Wall Spoils	~ 8,500 Cubic Yards
Piping Trench Spoils	~ 400 Cubic Yards
Vault Contents	~ 1,100 Gallons*
Septic Tank Liquids	~ 4,000 Gallons
Septic Tank Solids	~ 20 Cubic Yards
Transformer Pad Concrete	~ 5 Cubic Yards
Transformer Pad Soil	~ 2 Cubic Yards

Notes: Volumes are best estimates based on available information. Volumes may vary as a result of detailed design or as a result of conditions encountered in the field during construction.
* Vault contents have already been removed.

TABLE 3-1

INTERIM RESPONSE ACTION COST ESTIMATE
STANDARD CHLORINE CHEMICAL COMPANY SITE
KEARNY, NEW JERSEY

Item		Description	Onsite Consolidation
CAPITAL COSTS			
0.0	**Predesign Investigation Activities**		
	0.01	Labor and Other Directs	$420,074
	Subtotal		***$420,074***
1.0	**Site Preparation Activites**		
	1.01	Mobilization/Demobilization	$75,000
	1.02	Temporary Erosion Control/Fencing	$20,000
	1.03	Clearing and Grubbing	$6,250
	1.04	Building Demolition	$0
	1.05	Transformer Pad Demolition	$5,000
	1.06	Drums	$217,000
	1.07	Septic Tanks (5) / Vaults (1)	$150,000
	1.08	Storm Sewer Abandonment	$19,000
	1.09	Storm Sewer Construction	$225,000
	1.10	Temporary Water Management	$60,000
	Subtotal		***$777,250***
2.0	**DNAPL/Groundwater**		
	2.01	Monitoring Well Abandonment	$25,000
	2.02	DNAPL Collection Sumps	$221,000
	Subtotal		***$246,000***
3.0	**IRAW Barrier Walls**		
	3.01	River Side SSP/Slurry Wall	$765,000
	3.02	Manage Spoils Onsite	$16,667
	Subtotal		***$781,667***
4.0	**Leveling Layer - Structural Fill/Regrading**		
	4.01	Regrading	$2,700
	Subtotal		***$2,700***
5.0	**AOC Cover System**		
	5.01	Geogrids and Placement	$71,250
	5.02	Capillary Break Layer	$87,120
	5.03	Pavement Subbase Layer	$52,272
	Subtotal		***$210,642***
6.0	**Site Hackensack River Sediments**		
	6.01	River Sediment Excavation	$33,000
	6.02	River Sediment Stabilization	$11,000
	6.03	River Sediment Placement	$22,000
	Subtotal		***$66,000***

TABLE 3-1

INTERIM RESPONSE ACTION COST ESTIMATE
STANDARD CHLORINE CHEMICAL COMPANY SITE
KEARNY, NEW JERSEY

Item	Description		Onsite Consolidation
CAPITAL COSTS (Continued)			
7.0	**East and West Lagoons**		
	7.01	Lagoon Water Management	$100,000
	Subtotal		***$100,000***
8.0	**South Ditch**		
	8.01	Ditch Water Management	$10,000
	8.02	Ditch Sediment Excavation	$18,500
	8.03	Ditch Sediment Stabilization	$9,250
	8.04	Ditch Sediment Placement	$18,500
	Subtotal		***$56,250***
9.0	**Hydraulic Control Barrier Wall Construction**		
	9.01	Slurry Wall Installation (Site)	$928,125
	9.02	Manage Spoils Onsite	$20,625
	Subtotal		***$948,750***
10.0	**Hydraulic Control Recovery Well System (Full Enclosure)**		
	10.01	Recovery Well Installation	$17,325
	10.02	Wellhead Completions, Vaults, Pumps	$66,000
	10.03	Trenching for Piping Runs	$13,500
	10.04	Manage Excess Spoils Onsite	$1,215
	10.05	Manage Excess Spoils Offsite	$35,438
	10.06	Piping & Wiring Runs	$48,600
	10.07	Tees, Elbows, Valves	$7,290
	Subtotal		***$189,368***
11.0	**Hydraulic Control Groundwater Treatment Sytem**		
	11.01	Organics Treatment System	$100,000
	Subtotal		***$100,000***
12.0	**Design/Permitting/CQA/DER/CEA**		
	12.01	Design	$289,842
	12.02	Permits	$75,000
	12.03	CQA	$333,542
	12.04	Remedial Action Report	$45,000
	12.05	DER and CEA	$10,000
	Subtotal		***$753,384***
TOTAL CAPITAL COST			***$4,652,084***

TABLE 3-1

INTERIM RESPONSE ACTION COST ESTIMATE
STANDARD CHLORINE CHEMICAL COMPANY SITE
KEARNY, NEW JERSEY

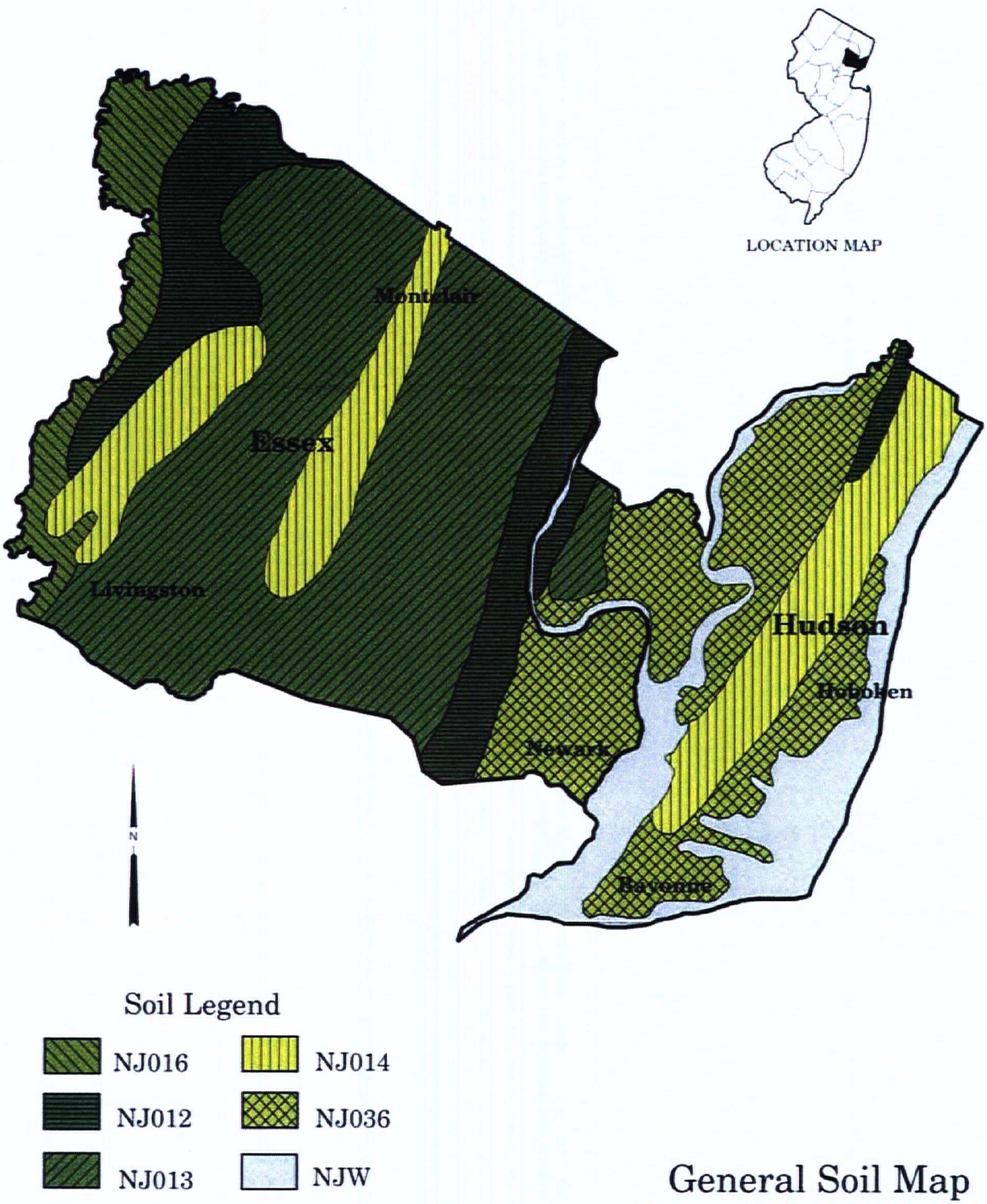
Item	Description		Onsite Consolidation
OPERATION AND MAINTENANCE COSTS			
13.0	**Groundwater Monitoring**		
	13.01	Annual Monitoring	$92,971
	Subtotal		***$92,971***
14.0	**DNAPL Recovery System O&M**		
	14.01	Annual O&M	$223,129
	Subtotal		***$223,129***
15.0	**Groundwater Treatment System O&M**		
	15.01	Present Worth of O&M (Organics)	$185,941
	Subtotal		***$185,941***
16.0	**Final Cover System Inspection and Maintenance**		
	16.01	Present Worth of Annual Costs	$9,297
	Subtotal		***$9,297***
TOTAL PRESENT WORTH OF ANNUAL COSTS			**$511,338**
TOTAL PRESENT WORTH			**$5,163,422**

APPENDIX A

SOIL CLASSIFICATION INFORMATION

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



General Soil Map
Essex and Hudson Counties
New Jersey

0 1 2 3 4 5
MILES

SOURCE: Data compiled from SCS State Soil Geographic Database, U.S. Census TIGER data. Universal Transverse Mercator Projection, June 1993

SEPTEMBER 1993 1007822

USDA SCS NATIONAL CARTOGRAPHY & GIS CENTER FORT WORTH TX 1994

Essex and Hudson Counties - New Jersey

This general soil map shows the soils associations in Essex and Hudson Counties, New Jersey. Each map unit is a unique natural landscape with a distinctive pattern of soils, relief, and drainage. Typically, a map unit consists of three or more major soils and some minor soils. The soils making up one unit can occur in other units but in a different pattern.

The named components in a particular association, such as URBAN LAND-DUNELLEN-RIVERHEAD, are listed in descending order of occurrence in the map unit. URBAN LAND describes areas where 80 percent or more of the surface is covered with impervious material. No attempt is made to describe soils in this component of the association.

This map can be used to compare the suitability of large areas for general land uses. Because of its small scale, it is not suitable for planning the management of a farm, field or for selecting a site for a road, building or other structure. This map is not a substitute for on-site soil investigations for intensive land use planning.

Map Unit Symbol	Association Name	Description
NJ012	URBAN LAND-DUNELLEN-RIVERHEAD -	Nearly level to strongly sloping, deep and very deep, well drained gravelly, sandy loams. These soils formed in sandy, stratified glacial outwash on outwash plains and terraces and on river and stream terraces. Hydrologic group B. These soils are non-hydric.
NJ013	URBAN LAND-BOONTON-WETHERSFIELD -	Gently sloping to moderately steep, well drained and moderately well drained, very deep and deep gravelly loams formed in acid, reddish sandstone, shale, basalt and conglomerate glacial till over shale and basalt bedrock. These soils occur on upland glacial till plains and ridges. Hydrologic group C. These soils are non-hydric.
NJ014	BOONTON-URBAN LAND -WETHERSFIELD -	Gently sloping to very steep, well drained and moderately well drained, very deep and deep gravelly loams formed in acid, reddish sandstone, shale, basalt and conglomerate glacial till over shale and basalt bedrock. These soils occur on upland glacial till plains and ridges. Hydrologic group C. These soils are non-hydric.
NJ016	URBAN LAND-PARSIPPANY-HALEDON -	Nearly level to strongly sloping, poorly drained and somewhat poorly drained, very deep silt loams. Parsippany soils are poorly drained and formed in stratified, silty, old lake sediments in depressions and on low, level areas. Haledon soils formed in sandstone, shale and basalt glacial till over shale and basalt bedrock along drainageways, on broad till plains and ridges, and at the bases of till plains and ridges. Parsippany soils are in hyrologic group C/D and are hydric. Haledon soils are in hydrologic group C and are non-hydric.
NJ036	SULFAQUENTS-UDORTHENTS-PSAMMENTS -	Nearly level, very poorly drained, very deep mineral and organic soils on tide-flooded flats, and similar areas overlain by fill materials. Hydrologic group not assigned. Sulfaquents are hydric.
NJW	WATER	NJW WATER

Information:

Contact:	District Conservationist
Location:	USDA-SCS Courthouse Morristown, NJ 07960
Telephone:	(201) 538-1552

APPENDIX B

WETLAND CLASSIFICATION AND MAPS

WETLANDS AND DEEPWATER HABITATS CLASSIFICATION

SYSTEM: M - MARINE

SUBSYSTEM: 1 - SUBTIDAL

CLASS / Subclass:

- **RB – ROCK BOTTOM**: 1 Bedrock; 2 Rubble
- **UB – UNCONSOLIDATED BOTTOM**: 1 Cobble-Gravel; 2 Sand; 3 Mud; 4 Organic
- **AB – AQUATIC BED**: 1 Algal; 3 Rooted Vascular; 5 *Unknown Submergent*
- **RF - REEF**: 1 Coral; 3 Worm
- **OW - *OPEN WATER/ Unknown Bottom***

SUBSYSTEM: 2 - INTERTIDAL

CLASS / Subclass:

- **AB – AQUATIC BED**: 1 Algal; 3 Rooted Vascular; 5 *Unknown Submergent*
- **RF– REEF**: 1 Coral; 3 Worm
- **RS – ROCKY SHORE**: 1 Bedrock; 2 Rubble
- **US - UNCONSOLIDATED SHORE**: 1 Cobble-Gravel; 2 Sand; 3 Mud; 4 Organic

SYSTEM: E - ESTUARINE

SUBSYSTEM: 1 - SUBTIDAL

CLASS / Subclass:

- **RB - ROCK BOTTOM**: 1 Bedrock; 2. Rubble
- **UB – UNCONSOLIDATED BOTTOM**: 1 Cobble-Gravel; 2 Sand; 3 Mud; 4 Organic
- **AB – AQUATIC BED**: 1 Algal; 3 Rooted Vascular; 4 Floating Vascular; 5 *Unknown Submergent*; 6 *Unknown Surface*
- **RF – REEF**: 1 Mollusc; 2 Worm
- **OW - *OPEN WATER/ Unknown Bottom***

SUBSYSTEM: 2 - INTERTIDAL

CLASS / Subclass:

- **AB – AQUATIC BED**: 1 Algal; 3 Rooted Vascular; 4 Floating Vascular; 5 *Unknown Submergent*; 6 *Unknown Surface*
- **RF– REEF**: 1 Mollusc; 2 Worm
- **SB – STREAMBED**: 1 Cobble Gravel; 2 Sand; 3 Mud; 4 Organic
- **RS - ROCKY SHORE**: 1 Bedrock; 2 Rubble
- **US – UNCONSOLIDATED SHORE**: 1 Cobble-Gravel; 2 Sand; 3 Mud; 4 Organic
- **EM -EMERGENT**: 1 Persistent; 2 Nonpersistent
- **SS – SCRUB-SHRUB**: 1 Broad-Leaved Deciduous; 2 Needle-Leaved Deciduous; 3 Broad-Leaved Evergreen; 4 Needle-Leaved Evergreen; 5 Dead; 6 *Deciduous*; 7 *Evergreen*
- **FO – FORESTED**: 1 Broad-Leaved Deciduous; 2 Needle-Leaved Deciduous; 3 Broad-Leaved Evergreen; 4 Needle-Leaved Evergreen; 5 Dead; 6 *Deciduous*; 7 *Evergreen*

SYSTEM: R - RIVERINE

SUBSYSTEM: 1 – TIDAL; 2 – LOWER PERENNIAL; 3 – UPPER PERENNIAL; 4 – INTERMITTENT; 5 – *UNKNOWN PERENNIAL*

CLASS / Subclass:

- **RB – ROCK BOTTOM**: 1 Bedrock; 2 Rubble
- **UB – UNCONSOLIDATED BOTTOM**: 1 Cobble-Gravel; 2 Sand; 3 Mud; 4 Organic
- ***SB – STREAMBED**: 1 Bedrock; 2 Rubble; 3 Cobble Gravel; 4 Sand; 5 Mud; 6 Organic; 7 Vegetated
- **AB – AQUATIC BED**: 1 Algal; 2 Aquatic Moss; 3 Rooted Vascular; 4 Floating Vascular; 5 *Unknown Submergent*; 6 *Unknown Surface*
- **RS – ROCKY SHORE**: 1 Bedrock; 2 Rubble
- **US – UNCONSOLIDATED SHORE**: 1 Cobble-Gravel; 2 Sand; 3 Mud; 4 Organic; 5 Vegetated
- ****EM – EMERGENT**: 2 Nonpersistent
- **OW – *OPEN WATER/ Unknown Bottom***

* STREAMBED is limited to TIDAL and INTERMITTENT SUBSYSTEMS, and comprises the only CLASS in the INTERMITTENT SUBSYSTEM.
** EMERGENT is limited to TIDAL and LOWER PERENNIAL SUBSYSTEMS.

Classification of Wetlands and Deepwater Habitats of the United States
Cowardin ET AL. 1979 as modified for National Wetland Inventory Mapping Convention

WETLANDS AND DEEPWATER HABITATS CLASSIFICATION

SYSTEM: L- LACUSTRINE

SUBSYSTEM: 1 - LIMNETIC

CLASS	RB – ROCK BOTTOM	UB – UNCONSOLIDATED BOTTOM	AB – AQUATIC BED	OW – *OPEN WATER/ Unknown Bottom*
Subclass	1 Bedrock 2. Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular *5 Unknown Submergent* *6 Unknown Surface*	

SUBSYSTEM: 2 - LITTORAL

CLASS	RB – ROCK BOTTOM	UB – UNCONSOLIDATED BOTTOM	AB – AQUATIC BED	RS – ROCKY SHORE	US – UNCONSOLIDATED SHORE	EM – EMERGENT	OW – *OPEN WATER/ Unknown Bottom*
Subclass	1 Bedrock 2. Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular *5 Unknown Submergent* *6 Unknown Surface*	1 Bedrock 2. Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	2 Nonpersistent	

SYSTEM: P - PALUSTRINE

CLASS	RB – ROCK BOTTOM	UB – UNCONSOLIDATED BOTTOM	AB – AQUATIC BED	US – UNCONSOLIDATED SHORE	ML – MOSS-LICHEN	EM – EMERGENT	SS – SCRUB-SHRUB	FO – FORESTED	OW – *OPEN WATER/ Unknown Bottom*
Subclass	1 Bedrock 2. Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular *5 Unknown Submergent* *6 Unknown Surface*	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	1 Moss 2 Lichen	1 Persistent 2 Nonpersistent	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead *6 Deciduous* *7 Evergreen*	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead *6 Deciduous* *7 Evergreen*	

MODIFIERS

In order to more adequately describe the wetland and deepwater habitats one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The farmed modifier may also be applied to the ecological system.

WATER REGIME

Non-Tidal

- A Temporarily Flooded
- B Saturated
- C Seasonally Flooded
- D *Seasonally Flooded/ Well Drained*
- E *Seasonally Flooded/ Saturated*
- F Semipermanently Flooded
- G Intermittently Exposed
- H Permanently Flooded
- J Intermittently Flooded
- K Artificially Flooded
- W Intermittently Flooded/Temporary
- Y Saturated/Semipermanent/ Seasonal
- Z Intermittently Exposed/Permanent
- U *Unknown*

Tidal

- K *Artificially Flooded*
- L Subtidal
- M Irregularly Exposed
- N Regularly Flooded
- P Irregularly Flooded
- *S Temporary-Tidal
- *R Seasonal-Tidal
- *T Semipermanent-Tidal
- *V Permanent-Tidal
- U *Unknown*

*These water regimes are only used in tidally influenced, freshwater systems.

WATER CHEMISTRY

Coastal Halinity

- 1 Hyperhaline
- 2 Euthaline
- 3 Mixohaline *(Brackish)*
- 4 Polyhaline
- 5 Mesohaline
- 6 Oligohaline
- 0 Fresh

Inland Salinity

- 7 Hypersaline
- 8 Eusaline
- 9 Mixosaline
- 0 Fresh

pH Modifiers for all Fresh Water

- a Acid
- t Circumneutral
- i Alkaline

SOIL

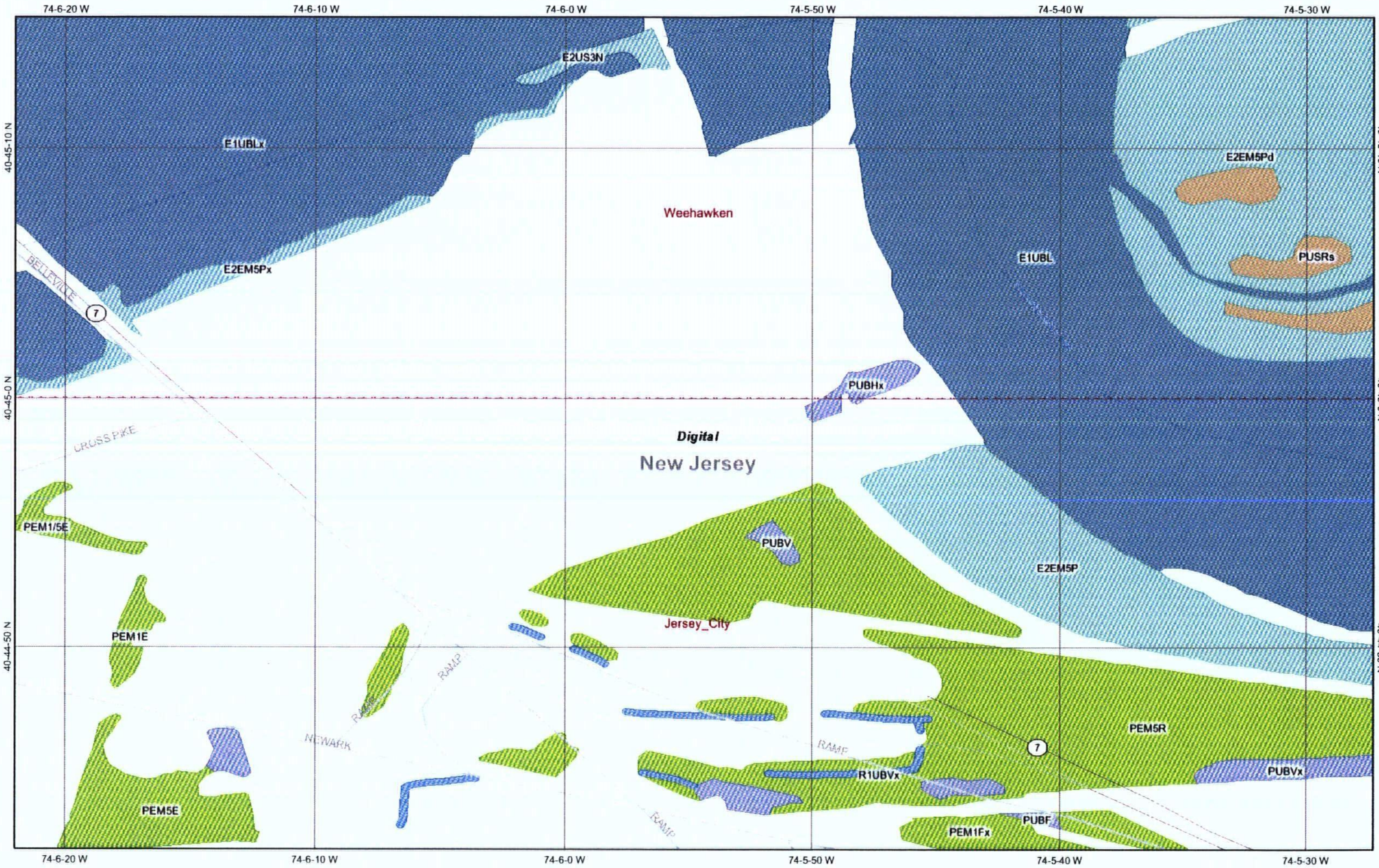
- g Organic
- n Mineral

SPECIAL MODIFIERS

- b *Beaver*
- d *Partially Drained/Ditched*
- f Farmed
- h *Diked/Impounded*
- r Artificial Substrate
- s *Spoil*
- x Excavated

NOTE: Italicized terms were added for mapping by the National Wetlands Inventory program.

National Wetlands Inventory Map (1:5,000)



Legend

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  - 1
  - Out of range
- Major Roads
  - Other Road
  - Interstate
  - State highway
  - US highway
- Roads
- Cities
- USGS Quad Index 24K
- Lower 48 Wetland Polygons
  - Estuarine and Marine Deepwater
  - Estuarine and Marine Wetland
  - Freshwater Emergent Wetland
  - Freshwater Forested/Shrub Wetland
  - Freshwater Pond
  - Lake
  - Other
  - Riverine
- Lower 48 Available Wetland Data
  - Non-Digital
  - Digital
  - No Data
  - Scan
- NHD Streams
- Counties 100K
- States 100K
- South America
- North America

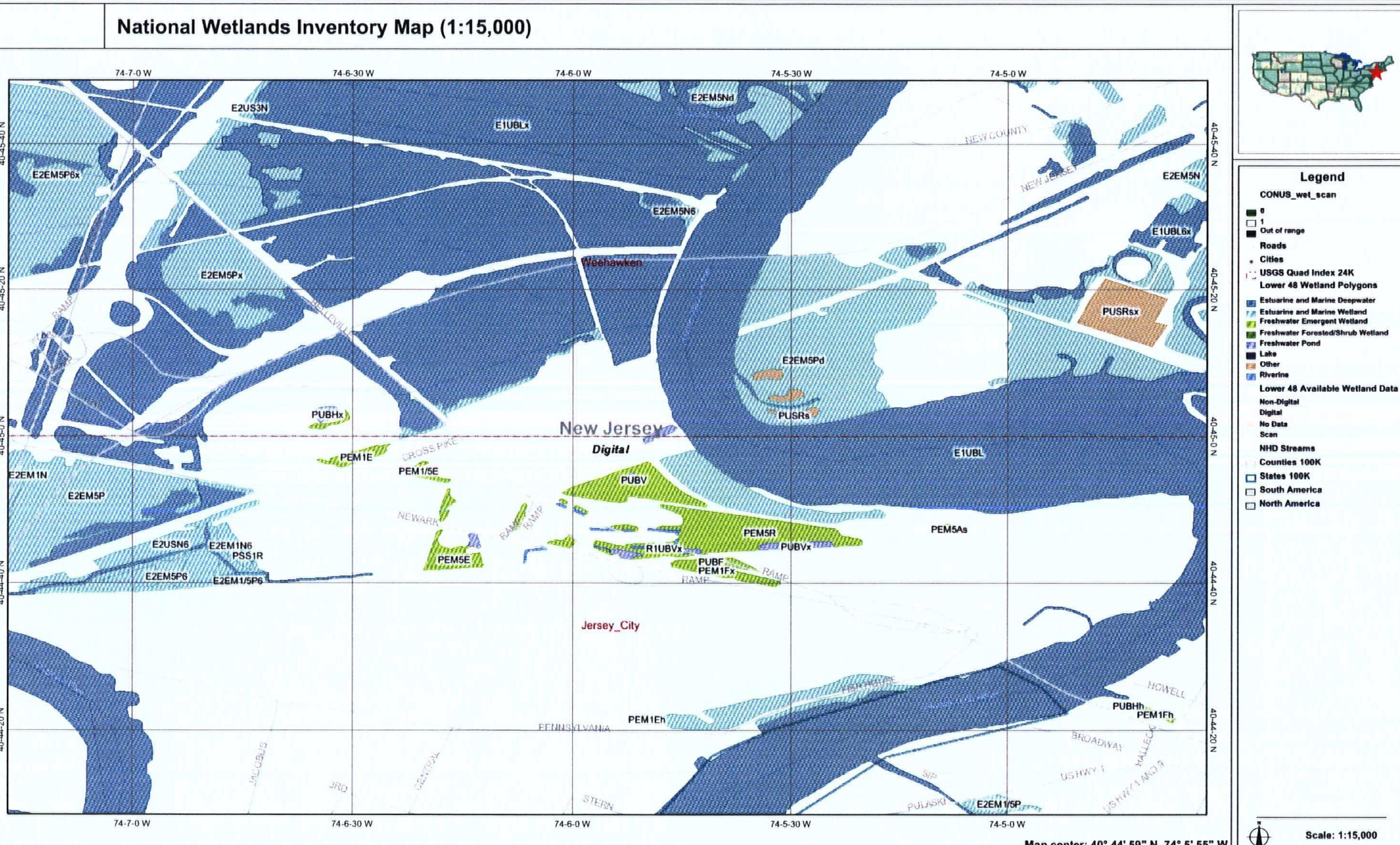
Scale: 1:5,000

Map center: 40° 44' 58.5" N, 74° 5' 54.6" W

This map is a user generated static output from an Internet mapping site and is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. THIS MAP IS NOT TO BE USED FOR NAVIGATION.

Notes: Source: U.S. Fish & Wildlife Service Wetlands Online Mapper

National Wetlands Inventory Map (1:15,000)

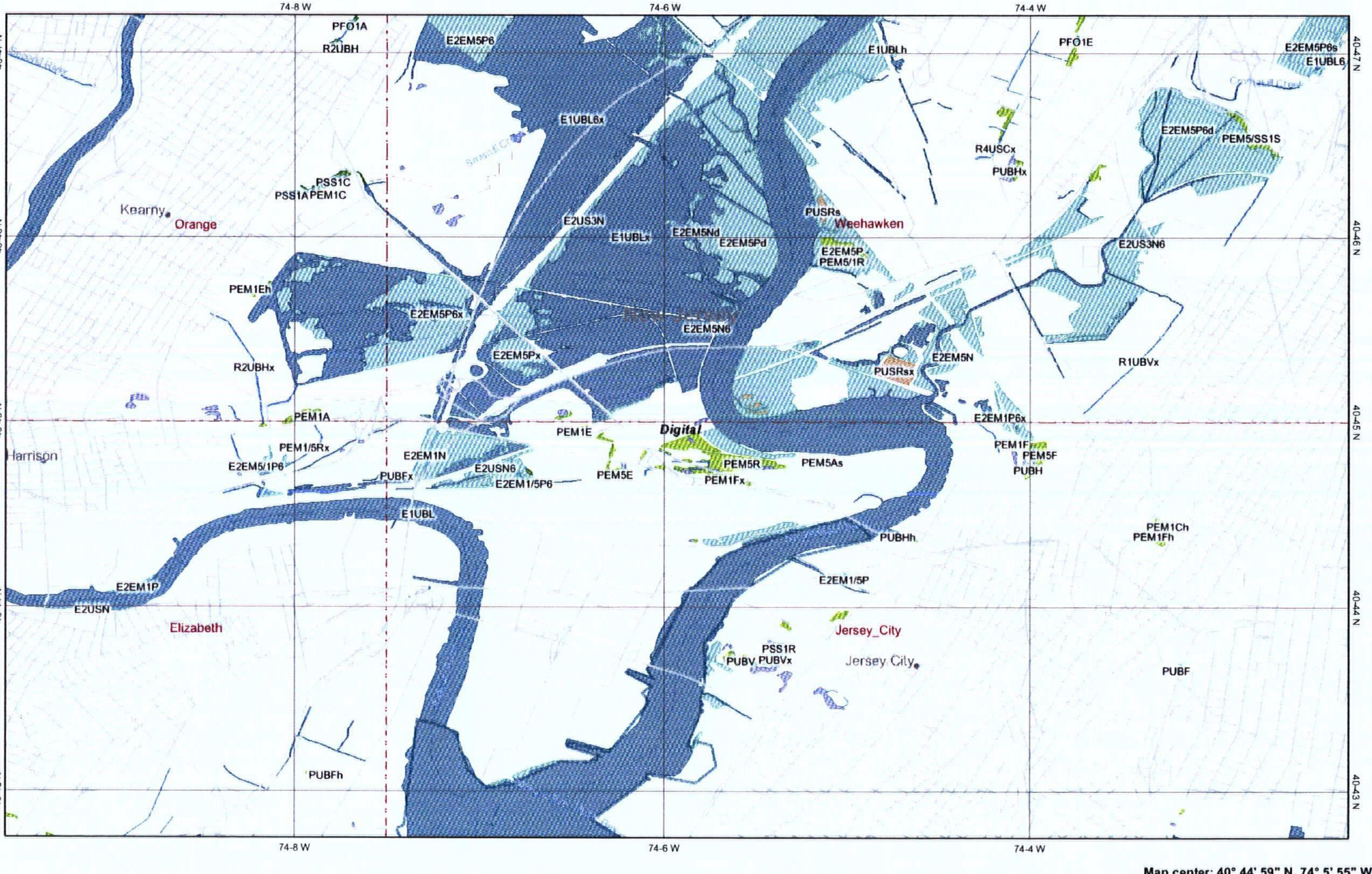


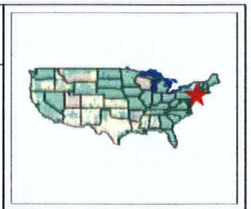
Map center: 40° 44' 59" N, 74° 5' 55" W

This map is a user generated static output from an Internet mapping site and is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. THIS MAP IS NOT TO BE USED FOR NAVIGATION.

Notes: Source: U.S. Fish & Wildlife Service Wetlands Online Mapper

National Wetlands Inventory Map (1:40,000)





Legend

- CONUS_wet_scan
  - 0
  - 1
  - Out of range
- Roads
- Cities
- USGS Quad Index 24K
- Lower 48 Wetland Polygons
  - Estuarine and Marine Deepwater
  - Estuarine and Marine Wetland
  - Freshwater Emergent Wetland
  - Freshwater Forested/Shrub Wetland
  - Freshwater Pond
  - Lake
  - Other
  - Riverine
- Lower 48 Available Wetland Data
  - Non-Digital
  - Digital
  - No Data
  - Scan
- NHD Streams
- Counties 100K
- States 100K
- South America
- North America

Scale: 1:40,000

This map is a user generated static output from an Internet mapping site and is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. THIS MAP IS NOT TO BE USED FOR NAVIGATION.

Notes: Source: U.S. Fish & Wildlife Service Wetlands Online Mapper

File: P:\0502\projects\0502007\GIS\MXD\2009WetlandSurvey.mxd, April 21, 2009, Copyright Princeton Hydro, LLC.

Wetland Acreage Summary Non-Regulated Wetlands

Wetland Type	SCCC Site	Diamond Site
Isolated Wetland	0.34	0.48
Total Acres per Site	0.34	0.48

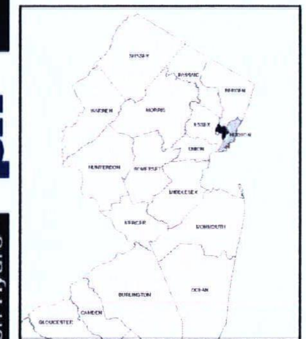
Wetland Acreage Summary Regulated Wetlands

Wetland Type	SCCC Site	Diamond Site
Freshwater Emergent Wetland	1.32	NA
Stable Spartina	0.03	0.03
Total Acres per Site	1.35	0.03

PH

Princeton Hydro

NEW JERSEY COUNTY MAP



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

1 inch = 200 feet

0 100 200 Feet

SOURCES:

1. Site boundaries are not an official PLS survey; inaccuracies may exist.

2. 2007 aerial photographs obtained from NJGIN Information Warehouse.

2009 WETLAND SURVEY

KEY ENVIRONMENTAL
STANDARD CHLORINE CHEMICAL
COMPANY & DIAMOND SITE
BLOCK 287
LOTS 46, 47, 48, 49, 50, 51, 52 & 52R
TOWN OF KEARNY
HUDSON COUNTY, NEW JERSEY

Legend

- Site Boundaries
- Isolated Wetlands
- Freshwater Emergent Wetlands
- Stable Spartina
- Non-Regulated Water Feature